AR201-14094

Edwin L Mongan <Edwin.L.Mongan-1@USA.dupont.com> on 12/02/2002 11:48:38 AM

To: oppt.ncic@epamail.epa.gov, Rtk Chem/DC/USEPA/US@EPA
cc: Georgia R Pugh <Georgia.R.Pugh@usa.dupont.com>, Jim_Keith@americanchemistry.com

Subject: Robust Summary and Test Plan for Mononitrile Category

Dear Sir or Madam,

Attached to this message is a .pdf file containing a cover letter, a Robust Data Summary and a Test Plan for the mononitriles chemical category, for the HPV Challenge Program. Mononitriles included in this group are 2-methyl-3-butenenitrile (2M3BN), 2-pentenenitrile (2-PN; including the cis and trans isomers), 3-pentenenitrile (3-PN; including the cis and trans isomers), and 4-pentenenitrile (4-PN). Please post this information on the EPA HPV Challenge website.

Regards,

Edwin L. Mongan
Manager, Environmental Stewardship
DuPont Company

(See attached file: Mononitrile category submission.pdf)

Mononitrile category submission.pdf

Safety, Health & Environment Excellence Center
1007 Market Street, DuPont 6082
Wilmington, DE 19898
302-773-0910 (Office) – 302-774-3140 (Fax)

November 12, 2002

Christine Todd Whitman, Administrator
U.S. Environmental Protection Agency
P.O. Box 1473
Merrifield, VA 2216

Attn: Chemical Right-to-Know Program

Dear Administrator Whitman,

E. I. du Pont de Nemours & Company, Inc. is pleased to submit the proposed test plan along with the robust summary for the chemical category designated the "mononitrile" category. Mononitriles included in this group are 2-Methyl-3-butenenitrile (CAS# 16529-56-9), 2-pentenenitrile (CAS# 13284-42-9), 3-pentenenitrile (CAS # 4635-87-4) and 4-Pentenenitrile (CAS# 592-51-8). DuPont understands there will be a 120-day review period for the test plan and that all comments received by the EPA will be forwarded to us for consideration.

This submission includes one electronic copy in .pdf format.

Please feel free to contact me with any questions or concerns you may have with regards to this submission at Edwin.L.Morgan-1@usa.dupont.com.

Sincerely,

Edwin L. Morgan, III
Manager, Environmental Stewardship
DuPont Safety, Health & Environment

Cc: Charles Auer – U.S. EPA
Office of Pollution Prevention & Toxics
U. S. Environmental Protection Agency
401 M Street, SW
Washington, DC 20460

AR201-14094A

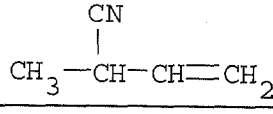
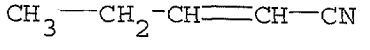
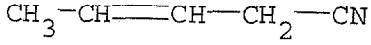
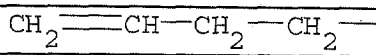
12 November 2002

ROBUST SUMMARY FOR 5-CARBON MONONITRILE CATEGORY

Summary

Identification of a structure based category:

The mononitrile category is composed of linear straight and branched chain alkanes with a common functional group, nitrile, at one end of the parent alkane chain. This category is composed of individual isomers containing five carbon atoms that differ by the position of a carbon to carbon double bond relative to the nitrile group. Mononitriles included in this group are 2-methyl-3-butenenitrile (2M3BN), 2-pentenenitrile (2-PN; including the cis and trans isomers), 3-pentenenitrile (3-PN; including the cis and trans isomers), and 4-pentenenitrile (4-PN). Structures of these mononitriles are presented below. Unless otherwise noted, data presented in this document for 2-PN and 3-PN will be for the mixture of the cis and trans isomers.

Chemical Name	CAS Registry Number	Structure
2-Methyl-3-butenenitrile	16529-56-9	
2-Pentenenitrile	13284-42-9	
3-Pentenenitrile	4635-87-4	
4-Pentenenitrile	592-51-8	

The terminal nitrile group and limited chain length provide similar structure activity relationships with these materials. The mononitriles are synthesized in the production of adiponitrile, as a desired product (3-PN), by-product (2M3BN), process stream (2-PN), or impurity (4-PN). In the data summaries, information will be presented that indicate these liquid materials share similar physical chemical properties, environmental fate characteristics, ecotoxicity, and mammalian toxicity.

Scientific literature was searched and summarized (Table 1). Each study on category materials was evaluated for adequacy. Robust summaries were developed for each study addressing specific SIDS endpoints. Summaries were also developed for studies either considered not adequate but provided information of relevance for hazard identification and evaluation, or covered non-SIDS endpoints (Appendices A-D).

12 November 2002

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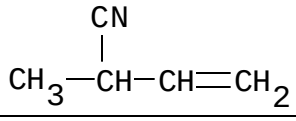
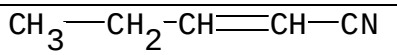
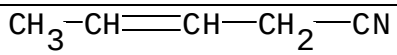
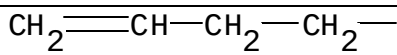
2-Methyl-3-butenenitrile	16529-56-9	
2-Pentenenitrile	13284-42-9	
3-Pentenenitrile	4635-87-4	
4-Pentenenitrile	592-51-8	

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Scientific literature was searched and summarized (Table 1). Each study on category materials was evaluated for adequacy. Robust summaries were developed for each study addressing specific SIDS endpoints. Summaries were also developed for studies either considered not adequate but provided information of relevance for hazard identification and evaluation, or covered non-SIDS endpoints (Appendices A-D).

Table 1: Matrix of Available and Adequate Data for Mononitrile Category

	2-Methyl-3-butenenitrile	2-Pentenenitrile	3-Pentenenitrile	4-Pentenenitrile
PHYSICAL/CHEMICAL CHARACTERISTICS				
Melting Point	N/A	N/A	N/A	N/A
Boiling Point	**v**	**v**	**v**	**v**
Vapor Pressure	**v**	**v**	**v**	**v**
Partition Coefficient (log Kow)	**v**	**v**	**v**	**v**
Water Solubility	**v**	**v**	**v**	**v**
ENVIRONMENTAL FATE				
Photodegradation	**v**	**v**	**v**	**v**
Stability in Water	**v**	**v**	**v**	**v**
Transport (Fugacity)	**v**	**v**	**v**	**v**
Biodegradation	**v**	**v**	**v**	**v**
ECOTOXICITY				
Acute Toxicity to Fish	**v**	**v**	**v**	**v**
Acute Toxicity to Invertebrates	**v**	**v**	**v**	**v**
Acute Toxicity to Aquatic Plants	**–**	**v**	**–**	**v**
MAMMALIAN TOXICITY				
Acute Toxicity	**v**	**v**	**v**	**v**
Repeated Dose Toxicity	**v/–**	**v**	**v/–**	**v/–**
Developmental Toxicity	**–**	**v/–**	**–**	**–**
Reproductive Toxicity	**–**	**–**	**–**	**–**
Genetic Toxicity Bacterial Gene Mutations	**v/–**	**v**	**v/–**	**–**
Genetic Toxicity Cellular Gene Mutations	**–**	**v**	**–**	**–**
Genetic Toxicity Chromosomal Aberrations	**–**	**–**	**–**	**–**

v = Data are available and considered adequate.
v/– = Data available, but considered inadequate.
– = No data available.
N/A = Not applicable.

Evaluation of Data Matrix Patterns:

The available data were broken out by discipline (physical chemical, environmental fate, ecotoxicology, and mammalian toxicology). These comparisons were conducted to determine if a pattern existed among the materials and to determine if additional testing needed to be conducted to complete the data set for the category.

All four mononitriles generally have equivalent physical chemical properties, as a result of structural similarity. Complete and adequate data (Table 2) correlate well with structure, and validate the category proposal.

Table 2: Physical and Chemical Characteristics*

	2-Methyl-3-butenenitrile	**2-Pentenenitrile**	**3-Pentenenitrile**	**4-Pentenenitrile**
Physical Appearance	Clear liquid, mild aromatic odor	Colorless liquid, pungent odor	Colorless to amber liquid	Liquid
Molecular Weight	81.12	81.12	81.12	81.12
Water Solubility	7850 mg/L @ 25°C (M) 6917 mg/L @ 22.5°C (E)	7930 mg/L @ 25°C (M) 7472 mg/L @ 22.5°C (E)	7930 mg/L @ 25°C (M) 7924 mg/L @ 22.5°C (E)	6794 mg/L @ 25°C (M)
Boiling Point	121-145°C	127°C	144-147°C	140°C
Vapor Pressure	11.1 mm Hg @ 25°C (M)	4.05 mm Hg @ 25°C (M)	4.05 mm Hg @ 25°C (M)	6.36 mm Hg @ 25°C (M)
Density/ Specific Gravity	0.8 @ 25°C	0.82 @ 20°C	0.83 @ 20°C	0.8239 @ 24°C
Partition Coefficient (Log Kow)	1.12 (M)	1.11 (M)	1.11 (M)	1.19 (M)
* Measured values are listed unless indicated as modeled (M) or estimated (E).				

Environmental fate data are essentially equivalent for the category members (Table 3). The data indicate that all 4 category members have a low potential for bioaccumulation. Biodegradation tests with 2M3BN, 2PN, and 3PN show that these test materials are not readily biodegradable, with biodegradation values of 8% after 21 days, 3% after 28 days, and 21% after 28 days, respectively. Fugacity modeling prediction for the mononitriles indicate these materials will act similarly in regard to partitioning to the environment. Modeled data show that all 4 test substances are essentially the same in terms of partitioning, with more material partitioning to the soil, and to a slightly lesser extent to water.

Table 3: Environmental Fate Data

	2-Methyl-3-butenenitrile	**2-Pentenenitrile**	**3-Pentenenitrile**	**4-Pentenenitrile**
Bioaccumulation Potential*	Low BCF = 1.45	Low BCF = 1.44	Low BCF = 1.44	Low BCF = 1.65
Biodegradation	Not Readily Biodegradable	Not Readily Biodegradable	Not Readily Biodegradable	Biodegrades Fast*
Fugacity*	Air 1.9% Water 44.1% Soil 53.9% Sediments 0.09%	Air 10.8% Water 46.3% Soil 42.8% Sediments 0.01%	Air 0.5% Water 45.1% Soil 54.3% Sediments 0.1%	Air 1.5% Water 42.6% Soil 55.0% Sediments 0.09%
* Modeled data.				

Aquatic toxicity of the mononitrile category is generally low with actual or estimated acute endpoints of greater than 100 mg/L (Table 4). The estimated 4-PN acute toxicity data for fish, invertebrates, and algae are consistent with the test data for the other members of the class, and support the observed low concern for acute aquatic toxicity of members of the mononitrile class. No estimated or actual data exist on the aquatic toxicity of 3-PN or 2M3BN to algae, however, the algal test data for 2-PN and the estimated algal toxicity data for 4-PN are consistent, both with each other, and with the low observed or estimated toxicity of the other mononitriles to fish and invertebrates. Available test data for fish, invertebrates, and algae indicate that the acute toxicity of the mononitrile compounds is of low concern.

Table 4: Aquatic Toxicity

	2-Methyl-3-butenenitrile	2-Pentenenitrile	3-Pentenenitrile	4-Pentenenitrile
Toxicity to Fish (96-hour LC_{50})	>100 mg/L (N)	316 mg/L (N)	>100 mg/L (N)	347 mg/L (E)
Toxicity to Invertebrates (48-hour EC_{50})	>100 mg/L (N)	114 mg/L (N)	>100 mg/L (N)	352 mg/L (E)
Toxicity to Algae (72-hour EC_{50})	No Data	263.5 mg/L (N)	No Data	210 mg/L (96-hour; E)
E = estimated value N = value based on nominal test concentrations				

The acute data that exists for these chemicals (Table 5) indicate that the chemicals produce similar toxicity profiles, with 2-PN and 3-PN being slightly more toxic than 2M3BN or 4-PN, and thus support a category approach. In mammalian species, 2M3BN and 4-PN exhibit slight toxicity via the oral and inhalation route, while 2-PN and 3-PN are moderately toxic. 2M3BN and 2-PN are moderately toxic via the dermal route, while no data is available for 3-PN or 4-PN. All 4 mononitriles are not skin irritants and are mild eye irritants, with the exception of 2-PN, which is a moderate eye irritant. Three of the 4 mononitriles are not skin sensitizers. No sensitization information is available for 2-PN; however, due to its structural similarity to the other members of the category, 2-PN is not expected to produce skin sensitization.

Table 5: Acute Mammalian Toxicity

	2-Methyl-3-butenenitrile	2-Pentenenitrile	3-Pentenenitrile	4-Pentenenitrile
Oral ALD (rat)	1000 mg/kg	450 mg/kg	300 mg/kg	2250 mg/kg
Inhalation LC_{50} (4-hour; rat)	3000 ppm	850 ppm	420 ppm	2550 ppm
Dermal LD_{50}	482 mg/kg	300 mg/kg*	No Data	No Data
Dermal Irritation	Not an irritant	Not an irritant	Not a primary irritant	Not an irritant
Eye Irritation	Mild	Moderate	Mild	Mild
Dermal Sensitization	Not a sensitizer	No Data	Not a sensitizer	Not a sensitizer
* Approximate Lethal Dose (ALD)				

A summary of the available data regarding repeated dose, developmental, and reproductive toxicity is shown in Table 6. Ten 4-hour exposures at 55 ppm (3-PN), 550 ppm (4-PN), and 560 ppm (2M3BN) did not reveal a NOAEL for any of the test substances, due to observed clinical signs. However, there was no clinical or pathologic indication of accumulation in exposed rats, and no histological evidence of primary injury by any of the 3 test substances in any of the examined tissues was observed. A 4-week inhalation study with 2-PN revealed a NOAEL of < 3 ppm for male rats based reduced body weights, 3 ppm for female rats based on microscopic nasal lesions and changes in sorbitol dehydrogenase activity, and 300 ppm for neurotoxicity in both male and female rats. In a 28-day oral study with 2-PN, no NOEL was reported. The lack of a NOEL was based on compound-related reductions in body weight and nutritional parameters, reductions in hindlimb grip strength (females only), and nasal lesions observed in male and female rats dosed with 10 mg/kg/day and above. Most parameters demonstrated at least partial reversal over a 2-month recovery phase; however, nasal histopathology did not demonstrate reversal.

Evaluation of developmental and reproductive toxicity for the mononitrile category cannot adequately be conducted with currently available data (Table 6). No studies have been conducted to examine the effects of any of these materials on developmental toxicity or male or female fertility. Histopathological evaluations of the gonads were conducted in some of the repeated dose studies, but were not sufficient to eliminate the possibility of an effect. Based on the similarity of results in acute and repeated dose studies for the mononitriles, it is anticipated that effects on fertility would be similar. As such it is proposed to evaluate the developmental and reproductive effects of 2-PN following OECD Guideline 422.

Table 6: Repeated Dose, Developmental, and Reproductive Toxicity

	2-Methyl-3-butenenitrile	**2-Pentenenitrile**	**3-Pentenenitrile**	**4-Pentenenitrile**
Repeated Dose Toxicity (NOAEL)	2-Week inhalation study: NOAEL not determined due to clinical signs at 560 ppm; no effects on body weight, mortality, or histopathology	4-Week inhalation study: NOAEL (male rats) < 3 ppm, based on body weight effects NOAEL (female rats) = 3 ppm, based on microscopic nasal lesions and changes in sorbitol dehydrogenase activity NOAEL (neurotoxicity, male and female rats) = 300 ppm 28-Day oral study: NOEL not determined due to reduced body weight, nutritional parameters, hindlimb grip strength (females only), and evidence of nasal lesions at 10 mg/kg/day	2-Week inhalation study: NOAEL not determined due to clinical signs at 55 ppm; no effects on body weight, mortality, or histopathology	2-Week inhalation study: NOAEL not determined due to clinical signs at 550 ppm; no effects on body weight, mortality, or histopathology
Developmental Toxicity	No Data	No Reliable Data	No Data	No Data
Reproductive Toxicity	No Data	No Data	No Data	No Data

2-PN, 2M3BN, and 3-PN were tested in the Ames test for mutagenicity. 2-PN was non-mutagenic when tested with and without exogenous metabolic activation in all strains tested (TA97, TA98, TA100, TA1535, TA1537). 2M3BN was non-mutagenic with and without exogenous metabolic activation in all strains tested (TA98, TA100, TA1535, TA1537, and TA97), except TA97 (without activation), in which the results were considered weakly mutagenic or equivocal. 3-PN was non-mutagenic with or without activation in strains TA98, TA1535, and TA1537, but was weakly mutagenic or equivocal with and without activation in strains TA97 and TA100. Although data for a mouse lymphoma test with 2-PN is available, it does not satisfy the requirement for chromosomal aberration testing. In order for this test to be considered a clastogenicity test, colonies needed to be sized, and this was not performed; therefore, this test was considered a gene mutation test. No data regarding chromosomal aberrations is available for any of the mononitriles, therefore a chromosomal aberration study for 2-PN is recommended following OECD Guideline 473.

Table 7: Genetic Toxicity

	2-Methyl-3-butenenitrile	**2-Pentenenitrile**	**3-Pentenenitrile**	**4-Pentenenitrile**
Mutagenic Potential (bacterial system)	Equivocal	Negative	Equivocal	No Data
Mutagenic Potential (tissue culture system)	No Data	Positive	No Data	No Data
Clastogenic Potential	No Data	No Data	No Data	No Data

Overall, the toxicological database for 2-pentenenitrile is nearly. The toxicological database for 2-methyl-3-butenenitrile, 3-pentenenitrile, and 4-pentenenitrile are somewhat limited, but the information available suggests a level of toxicity comparable to 2-pentenenitrile. The 4 chemicals are similar in chemical structure, physical and chemical characteristics, environmental toxicity, aquatic toxicity, and acute toxicity, with 2-PN and 3-PN being slightly more toxic than 2M3BN and 4-PN. Because of these similarities, it is reasonable to conclude that the category members would behave similarly in the areas where data gaps are evident: biodegradation (4-PN), acute toxicity to invertebrates (4-PN), acute toxicity to aquatic plants (2M3BN, 3-PN), repeated dose (2M3BN, 3-PN, 4-PN), developmental toxicity (2M3BN, 2-PN, 3-PN, 4-PN), reproductive toxicity (2M3BN, 2-PN, 3-PN, 4-PN), genetic toxicity for bacterial mutagenicity (2M3BN, 3-PN, 4-PN), and chromosomal aberrations (2-PN, 2M3BN, 3-PN, 4-PN). To add further support to this category approach, where data gaps exist for all members of the category, a combined repeated dose study and developmental/reproductive toxicity screen (OECD Guideline 422), and an *in vitro* chromosome aberration assay (OECD Guideline 473) of 2-PN are recommended. Table 8 lists the proposed test plan for the mononitrile category.

Table 8: Mononitrile Proposed SIDS Test Plan

	2M3BN	2-PN	3-PN	4-PN
Combined Repeated Dose Study and Developmental/ Reproductive Toxicity Screen	–*	–	–*	–*
Genetic Toxicity Chromosomal Aberrations	–*	–	–*	–*

– = No data available. Testing recommended.
* = Evaluation of the test substance will be considered based upon the results obtained from the study performed with 2-PN.

Exposure Assessment

Mononitriles are synthesized in the production of adiponitrile (ADN). Mononitriles are manufactured at two facilities, the Victoria Site & Sabine River Works (SRW). 3-Pentenenitrile (3-PN; desired product) and 4-pentenenitrile (4-PN; impurity) are completely consumed as site-limited intermediates in the production of ADN. 2-Methyl-3-butenenitrile (2M3BN) is a by-product and 99.75% is also consumed as a site limited intermediate in the production of ADN. The other 0.25% is sold to customers for use as a chemical intermediate in closed systems at industrial facilities. 2-Pentenenitrile (2-PN) is a stream from the ADN process where 83% is burned. 16.5% is sold to one customer for use as a chemical intermediate in a closed system at an industrial facility. 0.5% is sent to a toller that completely converts it to a new chemical.

DuPont facilities that produce mononitriles have effective safety, health & environmental practices and procedures in addition to engineering controls, environmental controls, and personal protective equipment to manage the risk of exposure. Both manufacturing facilities have from 250 to 2000 personnel (construction, contractor, and plant employees) working on site. The areas where the substances are manufactured have from 2 to 5 operators during normal operations and up to a total of 60 people during a shutdown or major construction activity. The toller and customers also have procedures, practices, and controls in place to manage the risk of exposure. DuPont assesses the ability of a potential toller to manage the risk of exposure prior to signing a contract and the contract specifies that any incidents must be reported to DuPont. DuPont also assesses the capability of a customer using the Product Stewardship Systems prior to selling a product. The Product Stewardship System works with customers around PPE (personal protective equipment), safety equipment (safety showers, eyewash stations, ventilation needs, etc.), storage concerns, disposal requirements, any MSDS questions, and getting an understanding of their application. No incidents have been reported to DuPont.

The potential for exposure is the greatest during the loading and unloading of the 2-PN and 2M3BN. Adequate safety equipment, such as safety showers, eyewash fountains, and washing facilities should be provided in the event of an occupational exposure.

Individuals handling mononitriles should avoid contact with eyes, skin, and clothing, thoroughly wash any exposed area of the skin after handling, and avoid breathing any dust. Workers use butyl gloves and Tychem 9400 acid suits. They are not required to wear respirators during the routine operation of the plant. No sites or customers have reported any SHE incidents from the handling of 2-PN or 2M3BN.

Air monitoring has been conducted on 2-PN, 3-PN and 2M3BN. TWA samples are trapped using tertbutylcatechol treated charcoal tubes, desorbed with 5% acetone in carbon disulfide, and analyzed using gas chromatography. The accuracy of the overall analysis is reported to be 10% when the sampling pump is calibrated with a charcoal tube in line. LOGAN (lognormal analysis) is a computerized statistical method for characterizing occupational exposures to chemicals, noise, and other environmental hazards. LOGAN uses sequential collection of data and makes decisions on the minimum amount of data. It helps make cost-effective, accurate decisions that ensure a healthy workplace. LOGAN uses inferential statistics to estimate the true workplace conditions; in the same way that public polling estimates opinions by sampling a representative percentage of the public. LOGAN is designed to limit the risk of employee occupational overexposure to less than 5%.

No DuPont Acceptable Exposure Limit (AEL) is established for 2-pentenenitrile but it is strongly recommended that exposure be controlled using the AEL established for a related 2-PN product containing 80% cis-2-PN: 0.3 ppm, 8- and 12-hour TWA, skin. The DuPont Acceptable Exposure Limit for 3-pentenenitrile is 1 ppm 8- and 12-hour TWA, skin. No DuPont Acceptable Exposure Limit is established for 2-methyl-3-butenentirile or 4-pentenenitrile. None of the samples taken suggest the probability of exposure in excess of the recommended DuPont AEL's.

EXPOSURE DATA

ADN PLANT

ADN Production Operators (No. of people = 88)				
Chemical	No. of Results	Avg. of TWA (ppm)	Min. of Results (ppm)	Max. of Results (ppm)
Methylbutenenitrile	134	0.0116	0.0096	0.1600
Pentenenitrile, 2-	134	0.0182	0.0096	0.7900
Pentenenitrile, 3-	134	0.0206	0.0096	0.2600

ADN I&E Maintenance (No. of people = 28)				
Chemical	No. of Results	Avg. of TWA (ppm)	Min. of Results (ppm)	Max. of Results (ppm)
Methylbutenenitrile	18	0.0099	0.0081	0.0100
Pentenenitrile, 2-	18	0.0099	0.0081	0.0100
Pentenenitrile, 3-	18	0.0105	0.0081	0.0200

ADN Maintenance Mechanics (No. of people = 39)				
Chemical	No. of Results	Avg. of TWA (ppm)	Min. of Results (ppm)	Max. of Results (ppm)
Methylbutenenitrile	91	0.0109	0.0081	0.0400
Pentenenitrile, 2-	91	0.0100	0.0081	0.0200
Pentenenitrile, 3-	91	0.0265	0.0081	0.7400

HMD PLANT

HMD Production Operators (No. of people 32)				
Chemical	No. of Results	Avg. of TWA (ppm)	Min. of Results (ppm)	Max. of Results (ppm)
Methylbutenenitrile	117	0.0128	0.0090	0.3500
Pentenenitrile, 2-	117	0.0099	0.0090	0.0100
Pentenenitrile, 3-	117	0.0108	0.0090	0.0500

HMD I&E Maintenance (No. of people 12)				
Chemical	No. of Results	Avg. of TWA (ppm)	Min. of Results (ppm)	Max. of Results (ppm)
Methylbutenenitrile	10	0.0096	0.0082	0.0100
Pentenenitrile, 2-	10	0.0096	0.0082	0.0100
Pentenenitrile, 3-	10	0.0156	0.0082	0.0700

HMD Maintenance Mechanics (No. of people 20)				
Chemical	No. of Results	Avg. of TWA (ppm)	Min. of Results (ppm)	Max. of Results (ppm)
Methylbutenenitrile	22	0.0098	0.0094	0.0100
Pentenenitrile, 2-	22	0.0098	0.0094	0.0100
Pentenenitrile, 3-	22	0.0139	0.0094	0.0700

POWER HOUSE EAST

Power House Production Operators (No. of people 17)				
Chemical	No. of Results	Avg. of TWA (ppm)	Min. of Results (ppm)	Max. of Results (ppm)
Methylbutenenitrile	11	0.0100	0.0097	0.0100
Pentenenitrile, 2-	11	0.0100	0.0097	0.0100
Pentenenitrile, 3-	11	0.0100	0.0097	0.0100

OLA PACKAGING WAREHOUSE

Contractor Operators at the Packaging Warehouse and the Landfills packages waste solids and ships the solids to Landfill

Zachry/Sentinel Packaging Warehouse and SELF (No. of people 2)				
Chemical	No. of Results	Avg. of TWA (ppm)	Min. of Results (ppm)	Max. of Results (ppm)
Methylbutenenitrile	12	0.0093	0.0088	0.0100
Pentenenitrile, 2-	12	0.0093	0.0088	0.0100
Pentenenitrile, 3-	12	0.0093	0.0088	0.0100

Appendix A

ROBUST SUMMARY FOR 2-METHYL-3-BUTENENITRILE

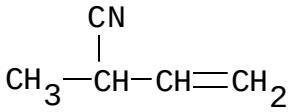
Existing published and unpublished data were collected and scientifically evaluated to determine the best possible study or studies to be summarized for each required endpoint. In the spirit of this voluntary program, other data of equal or lesser quality are not summarized, but are listed as related references at the end of each appropriate section, with a statement to reflect the reason why these studies were not summarized.

1.0 Substance Information

CAS Number: 16529-56-9

Chemical Name: 3-Butenenitrile, 2-methyl

Structural Formula:



Other Names: 3-Cyanobut-1-ene
2-Methyl allylcyanide
2M3BN
3-Cyanobutene-1

Exposure Limits: No Data.

2.0 Physical/Chemical Properties

2.1 Melting Point: Not Applicable.

2.2 Boiling Point

Value:	121-145°C
Decomposition:	Decomposes with heat
Pressure:	760 mm Hg
Method:	No Data
GLP:	Unknown
Reference:	DuPont Co. (2000). Material Safety Data Sheet No. DU000187 (June 24).
Reliability:	Not assignable because limited study information was available.

Additional References for Boiling Point: None Found.

2.3 Density

Value:	0.8
Temperature:	25°C
Method:	No Data
GLP:	Unknown
Results:	No additional data.
Reference:	DuPont Co. (2000). Material Safety Data Sheet No. DU000187 (June 24).
Reliability:	Not assignable because limited study information was available.

Additional References for Density: None Found.

2.4 Vapor Pressure

Value:	11.1 mm Hg
Temperature:	25°C
Decomposition:	No Data
Method:	Estimated using the mean of Antoine and Grain methods.
GLP:	Not Applicable
Reference:	SRC MPBPWIN v1.40 in EPIWIN v3.05.
	Syracuse Research Corporation (MPBPWIN) program estimates the boiling point (at 760 mm Hg), melting point, and vapor pressure of organic compounds. The vapor pressure is estimated using the mean of the Antoine and Grain methods. A description of the methodology is detailed in:
	Antoine Method: Lyman, W. J. et al. (1990). Handbook of Chemical Property Estimation Methods, Chapter 14, American Chemical Society, Washington, DC.
	Modified Grain Method: Lyman, W. J. (1985). In: Environmental Exposure From Chemicals, Volume I, Chapter 2, Neely, W. B. and G. E. Blau (eds.), CRC Press, Inc., Boca Raton, FL.
Reliability:	Estimated value based on accepted model.

Additional Reference for Vapor Pressure:

DuPont Co. (2000). Material Safety Data Sheet No. DU000187 (June 24).

2.5 Partition Coefficient (log Kow)

Value:	1.12
Temperature:	Not Applicable
Method:	Modeled. The KOWWIN computer program, version 1.66 from Syracuse Research Corporation, calculates the Log octanol/water partition coefficient (log Kow) of organic chemicals using an atom/fragment contribution method.
GLP:	Not Applicable
Reference:	The methodology is described in the following journal article: Meylan, W. M. and P. H. Howard (1995). J. Pharm. Sci., 84:83-92.
Reliability:	Estimated value based on accepted model.

Additional References for Partition Coefficient (log Kow): None Found.

2.6 Water Solubility

Value:	6917 mg/L
Temperature:	22.5°C
pH/pKa:	No Data
Method:	Water solubility of the test substance was estimated by determining the total organic carbon in water to which an amount of test substance in excess of the water solubility had been added. Samples were tested for their solubility in water after 48 and 96 hours of continuous mixing. Approximately 200 mg of the test substance, prepared in quadruplicate replicates, was added to 20 mL of deionized water in a glass test vessel with a Teflon®-coated screw cap. Two of the replicates were mixed end-over-end for 48 hours and then analyzed. The other 2 replicates were mixed end-over-end for 96 hours before analysis. Prior to analysis, the test vessels were allowed to stand for 1 hour. The upper 5 mL layer of solution was removed by pipette and discarded to eliminate test substance at the top of the test vessel. Samples were analyzed for total carbon content via an analyzer with an autosampler attachment. Water solubility was determined by assuming that the test material contained 100% test substances.
GLP:	No
Reference:	DuPont Co. (2002). Unpublished Data, Report No. EMSER 007-02, "Estimated Water Solubility of 2-Methyl-3-Butenenitrile" (January 24).

Reliability:	Medium because a suboptimal study design was used
Value:	7850 mg/L
Temperature:	25°C
pH/pKa:	No Data
Method:	Modeled
GLP:	Not Applicable
Reference:	WsKow v1.4 in EPIWIN v3.05 (SRC Database).
	WsKow estimates the water solubility (Wsol) of an organic compound using the compound's log octanol-water partition coefficient (log Kow). The following journal article describes the estimation methodology:
	Meylan, W. M. et al. (1996). Environ. Toxicol. Chem., 15:100-106.
Reliability:	Estimated value based on accepted model.

Additional Reference for Water Solubility:

DuPont Co. (2000). Material Safety Data Sheet No. DU000187 (June 24).

2.7 Flash Point

Value:	15°C
Method:	Closed cup
GLP:	Unknown
Reference:	DuPont Co. (2000). Material Safety Data Sheet No. DU000187 (June 24).
Reliability:	Not assignable because limited study information was available.

Additional References for Flash Point: None Found.

2.8 Flammability

Results:	Flammable liquid; vapor forms explosive mixture with air.
Method:	No Data
GLP:	Unknown
Reference:	DuPont Co. (2000). Material Safety Data Sheet No. DU000187 (June 24).
Reliability:	Not assignable because limited study information was available.

Additional References for Flammability: None Found.

3.0 Environmental Fate

3.1 Photodegradation

Concentration:	Not Applicable
Temperature:	Not Applicable
Direct Photolysis:	Not Applicable
Indirect Photolysis:	Not Applicable
Breakdown Products:	Not Applicable
Method:	The AOP Program, version 1.90 from Syracuse Research Corporation, estimates the Atmospheric Oxidation Potential. The AOP program estimates the rate constant for the atmospheric, gas-phase reaction between photochemically produced hydroxyl radicals and organic chemicals. The methodology used by the Atmospheric Oxidation Program is based upon the structure-activity relationship (SAR) methods developed by Dr. Roger Atkinson and co-workers (Atkinson et al., 1987; 1995; 1996; 1984). The rate constant for the reaction of 2-methyl-3-butenenitrile vapor with photochemically generated hydroxyl radicals in the atmosphere is estimated to be 2.6×10^{-11} cm^3/molecule-sec at 25°C (SRC AOPWin v1.90). This value corresponds to a half-life of 0.6 days, assuming a 24 hour day and an ambient hydroxyl radical concentration of 0.5×10^6 molecules/cm^3.
GLP:	Not Applicable
Reference:	Atkinson, R. et al. (1987). Intern. J. Chem. Kinet., 19:799-828. Atkinson, R. et al. (1995). Atmos. Environ., 29:1685-1695. Atkinson, R. et al. (1996). Environ. Sci. Technol., 30:329-334. Atkinson, R. et al. (1984). Chem. Rev., 84:437-470. The following journal article describes the AOP Program: Meylan, W. M. and P. H. Howard (1993). Chemosphere, 26:2293-2299.
Reliability:	Estimated value based on accepted model.

Additional References for Photodegradation: None Found.

3.2 Stability in Water

Concentration:	Not Applicable
Half-life:	The Henry's Law constant for 2-methyl-3-butenenitrile is estimated to be 5.33×10^{-5} atm-m^3/mole (SRC HENRYWIN v3.10 in EPIWIN v3.05) from its estimated vapor pressure of 11.1 mm Hg (SRC MPBPWIN v1.40 in EPIWIN v3.05, mean of Antoine & Grain methods) and water solubility of 7850 mg/L (WsKow v1.40 in EPIWIN v 3.05). The estimated volatilization half-life from a model river (1 m deep, flowing 1 m/sec, wind velocity of 5 m/sec) is approximately 10.8 hours. The estimated volatilization half-life from a model lake (1 m deep, flowing 0.05 m/sec, wind velocity of 0.5 m/sec) is approximately 8.1 days (EPIWIN v3.05).
% Hydrolyzed:	Not Applicable
Method:	Modeled. The WVOL program estimates the volatilization half-lives from a model river and lake using the methodology from Lyman et al., 1990 (adsorption to suspended solids and sediments is ignored). WsKow estimates the water solubility (WSol) of an organic compound using the compound's log octanol/water partition coefficient (log Kow).
GLP:	Not Applicable
Reference:	Lyman, W. J. et al. (1990). The Handbook of Chemical Property Estimation Methods, American Chemical Society, Washington, DC. The following journal article describes the estimation methodology: Meylan, W. M. et al. (1996). Environ. Toxicol. Chem., 15:100-106.
Reliability:	Estimated value based on accepted model.

Additional References for Stability in Water: None Found.

3.3 Transport (Fugacity)

Media:	Air, Water, Soil, and Sediments	
Distributions:	Air:	1.9%
	Water:	44.1 %
	Soil:	53.9%
	Sediments:	0.09%

Half-life:	Air:	8.8 hours
	Water:	360 hours
	Soil:	720 hours
	Sediment:	3240 hours
Adsorption Coefficient:	Not Applicable	
Desorption:	Not Applicable	
Volatility:	Not Applicable	
Method:	Calculated according to Mackay, Level III, Syracuse Research Corporation EPIWIN version 3.05. Emissions (1000 kg/hr) to air, water, and soil compartments using standard EPA model defaults with BIOWIN half-life factors of water, 1; soil, 2; and sediments, 9.	
	Data Used: Molecular Weight: 81.12 Henry's Law Constant: 5.33 x 10^{-5} atm-m^3/mole (HenryWin Program) Vapor Pressure: 11.1 mm Hg (MPBPWIN v1.40) Log Kow: 1.12 (KowWin Program) Soil Koc: 5.4 (Log Kow estimate)	
GLP:	Not Applicable	
Reference:	Syracuse Research Corporation EPIWIN v3.05 contains a Level III fugacity model. The methodology and programming approach were developed by Dr. Donald MacKay and coworkers and are detailed in: Mackay, D. (1991). Multimedia Environmental Models: The Fugacity Approach, pp. 67-183, Lewis Publishers, CRC Press. Mackay, D. et al. (1996). Environ. Toxicol. Chem., 15(9):1618-1626. Mackay, D. et al. (1996). Environ. Toxicol. Chem., 15(9):1627-1637.	
Reliability:	Estimated value based on accepted model.	

Additional References for Transport (Fugacity): None Found.

3.4 Biodegradation:

Value:	8% after 21 days (Not Readily Biodegradable)
Breakdown Products:	No Data
Method:	The procedures used in the test were based on the recommendations of the following guideline:

recommendations of the following guideline:

OECD Guideline 301B.

The biodegradability of 2-methyl-3-butenenitrile was tested using the Modified Sturm test. Biodegradability was measured as CO_2 evolution. A test substance is considered "Readily Biodegradable" if it demonstrates a "pass level" of 60% biodegradability within a 10-day window after exceeding the 10% level of biodegradability. A test substance is considered "Ultimately Biodegradable" if it demonstrates a "pass level" of 60% biodegradability, but not within a 10-day window after exceeding the 10% level of biodegradability.

2-Methyl-3-butenenitrile reached a peak of 8% biodegradability at day 21, and therefore is regarded as not "Readily Biodegradable." 2-Methyl-3-butenenitrile was not inhibitory to microorganisms in the inoculum.

GLP: No

Reference: DuPont Co. (2001). Unpublished Data, Report No. EMSE-072-01, "Biodegradability of 2-Methyl-3-Butenenitrile Using the Modified Sturm Test (OECD 301B)" (December 17).

Reliability: High because a scientifically defensible or guideline method was used.

Additional References for Biodegradation: None Found.

3.5 Bioconcentration

Value: BCF = 1.45. This BCF value suggests that bioconcentration potential in aquatic organisms is low.

Method: The bioconcentration factor is calculated by Syracuse Research Corporation's BCFWIN Computer Program, version 2.14, which utilizes a linear regression based on the log Kow for the compound.

GLP: Not Applicable

Reference: The estimation methodology used by BCFWIN is described in the following document prepared for the U.S. Environmental Protection Agency (OPPT): "Improved Method for Estimating Bioconcentration Factor (BCF) from Octanol-Water Partition Coefficient," SRC TR-97-006 (2^{nd} Update), July 22, 1997; prepared for Robert S. Boethling, EPA-OPPT, Washington, DC, Contract No. 68-D5-0012; prepared by William M. Meylan, Philip H. Howard, Dallas Aronson, Heather Printup, and Sybil

Howard, Dallas Aronson, Heather Printup, and Sybil Gouchie, Syracuse Research Corp., Environmental Science Center, 6225 Running Ridge Road, North Syracuse, NY 13212.

Reliability: Estimated value based on accepted model.

Additional References for Bioconcentration: None Found.

4.0 Ecotoxicity

4.1 Acute Toxicity to Fish

Type: **96-hour LC_{50}**
Species: *Pimephales promelas* (fathead minnow)
Value: >100 mg/L
Method: No specific test guideline was reported; however, a scientifically defensible approach was used that was consistent with OECD Guideline 203, with the following exceptions: 10x dose spacing, 4 test concentrations, and nominal test concentrations were reported.

The acute toxicity to fathead minnows was determined in an unaerated, 96-hour, static test. The nominal concentrations of 2-methyl-3-butenenitrile used were 0, 0.10, 1, 10, and 100 mg/L at a mean temperature of 21.6°C. One test chamber was used per test concentration with 10 test organisms in each chamber.

Analysis of the test and control solution samples for dissolved oxygen and pH were made at test initiation (0 hours) and test completion (96 hours).
GLP: No
Test Substance: 2-Methyl-3-butenenitrile, purity 87%
Results: Based on visual observations, the water control and the 0.1, 1, 10, and 100 mg/L test concentrations were clear and colorless at test start. All water quality parameters were within acceptable limits during the exposure. At test initiation (0 hours), dissolved oxygen was 8.7 mg/L and pH ranged from 7.5-7.7. At test completion (96 hours) dissolved oxygen and pH ranged from 6.1-7.1 and 7.4-7.6, respectively.

Exposure of fathead minnows to nominal concentrations of 0, 0.1, 1, 10, and 100 mg/L 2-methyl-3-butenenitrile resulted in 0% mortality at any concentration at the end of 96 hours. The test substance exhibited low concern for aquatic hazard in the unaerated, 96-hour, static, acute test using the fathead minnow.

	minnow.
Reference:	DuPont Co. (2001). Unpublished Data, Haskell Laboratory Report No. DuPont-8177, "Static, Acute, 96-Hour Screening Test to *Pimephales promelas*" (November 19).
Reliability:	Medium because a suboptimal study design was used (nominal test concentrations).

Additional References for Acute Toxicity to Fish: None Found.

4.2 Acute Toxicity to Invertebrates

Type:	**48-hour EC_{50}**
Species:	*Daphnia magna*
Value:	>100 mg/L
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used that was consistent with OECD Guideline 202, with the following exceptions: 10x dose spacing, 4 test concentrations, nominal test concentrations were reported, and 1 replicate per test concentration was performed. The acute toxicity of 2-methyl-3-butenenitrile to the water flea, *Daphnia magna* (less than 24-hours old) was determined in an unaerated, 48-hour, static test. The study was conducted at concentrations of 0, 0.1, 1.0, 10, and 100 mg/L at a mean temperature of 20.4°C (range of 20.1-20.7°C). One test chamber was used per test concentration with 10 test organisms in each chamber.
GLP:	No
Test Substance:	2-Methyl-3-butenenitrile, purity 87%
Results:	Based on visual observations, the water control and the 0.1, 1, 10, and 100 mg/L test concentrations were clear and colorless at test start. All water quality parameters were within acceptable limits during the exposure. Dissolved oxygen was 8.6-8.7 and 8.4-8.5 mg/L at test initiation (0 hours) and test completion (48 hours), respectively. pH was 7.4-7.9 and 7.7-7.9 at test initiation (0 hours) and test completion (48 hours), respectively. Immobility was 0% in all test concentrations at the end of 48 hours. No immobility or sublethal effects were observed in the water control test organisms. The highest nominal concentration causing no immobility at test end was 100 mg/L. The test substance exhibited low concern for aquatic hazard in an unaerated, 48-hour, static, acute test using *Daphnia magna* (less than 24 hours old).

Reference:	DuPont Co. (2001). Unpublished Data, Haskell Laboratory Report No. DuPont-8178, "Static, Acute, 48-Hour Screening Test to *Daphnia magna*" (October 26).
Reliability:	Medium because a suboptimal study design was used (nominal test concentrations).

Additional References for Acute Toxicity to Invertebrates: None Found.

4.3 Acute Toxicity to Aquatic Plants: No Data.

5.0 Mammalian Toxicity

5.1 Acute Toxicity

Type:	**Oral ALD**
Species/Strain:	Male rats/ChR-CD
Value:	1000 mg/kg
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study. 2-Methyl-3-butenenitrile, as a solution in peanut oil, was administered in single doses via intragastric intubation to young adult male rats (1/dose level) at 200, 300, 450, 670, 1000, 1500, 2250, or 5000 mg/kg. Survivors were sacrificed 14 days later without pathological examination. Clinical signs of toxicity and body weights were recorded.
GLP:	No
Test Substance:	2-Methyl-3-butenenitrile, purity approximately 100%
Results:	Mortality occurred at doses ≥ 1000 mg/kg within 5 days. Toxic signs observed at lethal doses included salivation, increased muscle tone, polyuria, irregular respiration, weight loss, hyperemic extremities, and unresponsiveness. The sublethal dose of 670 mg/kg caused weight loss for 3 days, salivation, increased muscle tone, rapid respiration, and inactivity. Throughout most of the recovery period, this rat was unkempt, emaciated, and exhibited nervous behavior. At 450 and 300 mg/kg, the rats showed toxic signs during the 1st recovery week, which included weight loss, polyuria, nervous behavior, hyperemia, and ruffled fur. Other than an initial weight loss, there were no effects observed in the rat dosed at 200 mg/kg.
Reference:	DuPont Co. (1967). Unpublished Data, Haskell Laboratory Report No. 199-67, "Acute Oral Test" (November 9) (also cited in TSCA fiche OTS0571510).
Reliability:	High because a scientifically defensible or guideline method

was used.

Additional References for Acute Oral Toxicity: None Found.

Type:	**Inhalation LC_{50}**
Species/Strain:	Male rats/ChR-CD
Exposure Time:	4 hours
Value:	3000 ppm (95% confidence limits, 2760-3261 ppm)
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study. Male rats (6/exposure level), weighing 250-289 g, were exposed to nominal concentrations of 815, 1060, 1540, 1812, 2416, 2870, 3200, or 3835, ppm 2-methyl-3-butenenitrile in a 16 L bell jar for 4 hours. The test substance was metered at a uniform rate into a heated stainless steel T-tube by a syringe drive and vaporized under prepurified nitrogen. The test substance vapors were mixed with oxygen and carried into the bell jar. Houseline air was used as diluent to give the desired atmospheric concentration. For analysis, gas samples were taken periodically from the chamber exit and analyzed by gas chromatography. Clinical signs were recorded during and post-exposure. Body weights were recorded. Gross and histopathologic examinations were performed on 2 rats each at 1, 2, 7, and 14 days post-exposure. Tissues examined included lungs, liver, spleen, kidney, testes, and thymus. The other survivors were sacrificed 14 days post-exposure.
GLP:	No
Test Substance:	2-Methyl-3-butenenitrile, purity approximately 100%
Results:	The analytical concentrations for the 815, 1060, 1540, 1812, 2416, 2870, 3200, and 3835 ppm exposure levels were not specified, not specified, not specified, 2480, 2600, 2945, 2875, and 3470 ppm, respectively. Mortality was 0/6, 0/6, 0/6, 0/6, 1/6, 1/6, 3/6, and 5/6 at 815, 1060, 1540, 1812, 2416, 2870, 3200, and 3835 ppm, respectively. Death occurred from 3.5 hours of exposure through the night following exposure. During exposure, clinical signs observed at lethal concentrations included irregular respiration, incoordination, lacrimation, salivation, inflamed eyes, red discharge from the eyes, hyperemia, pale ears, tremors, and unresponsiveness to sound. The same clinical signs, but less severe, were observed in animals at non-lethal doses. Post-exposure initial weight loss followed by normal weight gain was observed at lethal and non-lethal concentrations. Gross and histopathologic examinations

concentrations. Gross and histopathologic examinations revealed no anatomical evidence of primary injury.

Reference: DuPont Co. (1970). Unpublished Data, Haskell Laboratory Report No. 301-70, "Acute Inhalation Toxicity" (July 15) (also cited in TSCA fiche OTS0555686).

DuPont Co. (1968). Unpublished Data, Study Records (January 16).

Reliability: High because a scientifically defensible or guideline method was used.

Additional References for Acute Inhalation Toxicity: None Found.

Type: **Dermal LD_{50}**
Species/Strain: Male rabbits/New Zealand White
Exposure Time: 24 hours
Value: 482 mg/kg
Method: No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study.

Four groups of 6 adult male rabbits were clipped free of hair over the back and trunk area and fitted with plastic collars. The test substance (250, 325, 400, or 700 mg/kg) was applied to the intact skin on the back of each rabbit under a gauze pad. The trunk of each rabbit was then wrapped with a layer of plastic wrap, stretch gauze bandage, and elastic adhesive tape. After a 24-hour exposure period, the wrappings were removed, and the rabbits were wiped with a dry towel and returned to their cages. The rabbits were observed and/or weighed daily (except weekends) over a 14-day recovery period and then sacrificed. The LD_{50} value was calculated using the method of D. J. Finney.

GLP: No
Test Substance: 2-Methyl-3-butenenitrile, purity 74%
Results: Mortality was 0/6, 2/6, 3/6, and 4/6 at 250, 325, 400, and 700 mg/kg, respectively. All deaths occurred within 1 day after dosing. Weight loss was observed at all dose levels tested. Clinical signs of toxicity observed on the day of dosing or the day following dosing included prostration (one rabbit at 700 mg/kg) and weakness (one rabbit each at 400 and 700 mg/kg). In addition one rabbit at 250 mg/kg was observed not to be eating on day 5 following dosing.
Reference: DuPont Co. (1983). Unpublished Data, Haskell Laboratory Report No. 40-83, "Acute Skin Absorption LD_{50} Test on Rabbits" (March 1) (also cited in TSCA fiche OTS0570961).

Reliability:	High because a scientifically defensible or guideline method was used.

Additional References for Acute Dermal Toxicity: None Found.

Type:	**Dermal Irritation**
Species/Strain:	Male guinea pigs/Albino
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study. In a test for primary irritation, applications of 1 drop of the undiluted sample (100%) or of a solution in 1:1 acetone-dioxane containing 13% guinea pig fat (f.a.d.) were applied to the intact shaved skin of 10 male albino guinea pigs. The final concentrations were 100%, 50%, and 25%. Reactions were observed after 1 and 2 days.
GLP:	No
Test Substance:	2-Methyl-3-butenenitrile, purity approximately 100%
Results:	No skin reaction was observed 1 or 2 days after treatment with 100%, 50% (observed only 1 day after treatment), or 25% 2-methyl-3-butenenitrile.
Reference:	DuPont Co. (1969). Unpublished Data, Haskell Laboratory Report No. 230-69, "Primary Skin Irritation and Sensitization Tests" (August 13).
Reliability:	High because a scientifically defensible or guideline method was used.

Additional References for Dermal Irritation: None Found.

Type:	**Dermal Sensitization**
Species/Strain:	Male guinea pig/Albino
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study. In the test for sensitization potential, an exposure series was given during a 3-week interval. Five guinea pigs received 9 applications of 100% 2-methyl-3-butenenitrile, and 5 others received 4 intradermal injections (each 0.1 mL of a 1% solution, based on corrected specific gravity value, in dimethyl phthalate). A 2-week rest period was followed by a challenge test consisting of applications of 100% test substance and 50% solution (based on corrected specific gravity value) in 1:1 acetone-dioxane containing 13% guinea pig fat (f.a.d.) to both intact and abraded skin. Sensitization reactions were observed at 1 and 2 days.

	reactions were observed at 1 and 2 days.
GLP:	No
Test Substance:	2-Methyl-3-butenenitrile, purity approximately 100%
Results:	Sensitization reactions at the challenge phase included 1 guinea pig with mild erythema at 100% in intact skin at the 1-day observation. All other readings for intact and abraded skin were negative. 2-Methyl-3-butenenitrile was not a skin sensitizer when tested in albino guinea pigs.
Reference:	DuPont Co. (1969). Unpublished Data, Haskell Laboratory Report No. 230-69 "Primary Skin Irritation and Sensitization Tests" (August 13).
Reliability:	High because a scientifically defensible or guideline method was used.

Additional References for Dermal Sensitization: None Found.

Type:	**Eye Irritation**
Species/Strain:	Rabbits/Albino
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study. Undiluted 2-methyl-3-butenenitrile (0.1 mL) was instilled into the right conjunctival sac of each of 2 albino rabbits. Twenty seconds after contact, 1 exposed eye was washed with tap water for 1 minute. The exposed eye of the other rabbit was not washed. Observations were made with a hand slit lamp at 1 and 4 hours, and at 1, 2, 3, and 7 days. Fluorescein stain and a biomicroscope were used at examinations after the day of treatment.
GLP:	No
Test Substance:	2-Methyl-3-butenenitrile, purity approximately 100%
Results:	2-Methyl-3-butenenitrile produced temporary, very mild corneal injury and conjunctival irritation in the unwashed rabbit eye. Another eye similarly dosed and promptly washed showed only temporary, mild conjunctival irritation.
Reference:	DuPont Co. (1969). Unpublished Data, Haskell Laboratory Report No. 230-69, "Eye Irritation Test" (August 13).
Reliability:	High because a scientifically defensible or guideline method was used.

Additional References for Eye Irritation: None Found.

5.2 Repeated Dose Toxicity

Type:	**2-Week Inhalation Study**
Species/Strain:	Rats/ChR-CD
Sex/Number:	Male/6
Exposure Period:	2 weeks (total of 10 exposures)
Frequency of Treatment:	4 hours/day
Exposure Level:	560 ppm
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study. Six male rats, weighing 250-289 g, were exposed to 2-methyl-3-butenenitrile in a 16 L bell jar 4 hours/day for 2 weeks. The test substance was metered at a uniform rate into a heated stainless steel T-tube by a syringe drive and vaporized under prepurified nitrogen. The test substance vapors were mixed with oxygen and carried into the bell jar. Houseline air was used as diluent to give the desired atmospheric concentration. For analysis, gas samples were taken periodically from the chamber exit and analyzed by gas chromatography. Clinical signs and body weights were recorded during and post-exposure. Gross and histopathologic examinations were performed, and included lungs, liver, spleen, kidney, testes, and thymus.
GLP:	No
Test Substance:	2-Methyl-3-butenenitrile, purity approximately 100%
Results:	At 560 ppm, no mortality was observed. Clinical signs during exposure included irregular respiration, hypersensitivity, red discharge around the eyes, salivation, pale ears, piloerection (during the 5^{th}, 6^{th}, and 8^{th} exposures), and no weight gain during the exposure period. Post-exposure, animals had normal weight gain, and no clinical signs were observed. Gross and histopathologic examination showed no evidence of primary injury by the test substance.
Reference:	DuPont Co. (1970). Unpublished Data, Haskell Laboratory Report No. 301-70, "Subacute Inhalation Toxicity" (July 15) (also cited in TSCA fiche OTS0555686).
Reliability:	Medium because a suboptimal study design was used.

Additional References for Repeated Dose Toxicity: None Found.

5.3 Developmental Toxicity: No Data.

5.4 Reproductive Toxicity: No Data.

5.5 Genetic Toxicity

Type:	***In vitro* Bacterial Reverse Mutation Test**
Tester Strain:	*Salmonella typhimurium* strains TA97, TA98, TA100, TA104, TA1535, and TA1537
Exogenous Metabolic Activation:	With and without 10 and 30% Aroclor®-induced rat and hamster liver S-9
Exposure Concentrations:	Initial Trial: 0, 10, 33, 100, 333, 1000, 3333, and 6666 or 6667 µg/plate Subsequent Trials: 0, 33, 100, 333, 1000, 3333, and 6666 or 6667 µg/plate Comment: Not all exposure concentrations were tested with all tester strains under all test conditions.
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study. The preincubation method originally described by Haworth et al., 1983 was used with some modifications. The test substance, overnight culture of *Salmonella*, and S-9 mix or buffer were incubated at 37°C, without shaking for 20 minutes. Test substances known or suspected to be volatile were incubated in capped tubes. The top agar was added and the contents of the tubes were mixed and poured onto the surface of petri dishes containing medium. Histidine-independent (his+) colonies arising on these plates were counted following 2 days incubation at 37°C. Plates were machine counted (New Brunswick, Artek). At the discretion of the investigator, plates with low numbers of colonies, containing precipitated test substance, or having excessively-reduced contrast because of chemical color, were counted by hand. The initial test of a test substance was without activation and with 10% S-9. If a positive result was obtained, the positive trial(s) was repeated. If the trials were negative the test substance was retested without S-9 and with 30% S-9. If all trials were negative, no further testing was performed. A test substance was designated nonmutagenic only after it had been tested in strains TA97, TA98, TA100, TA1535, and TA1537, without exogenous activation, and with 10%

and TA1537, without exogenous activation, and with 10% and 30% rat and hamster S-9.

2-Methyl-3-butenenitrile was run initially in a toxicity assay using TA100 or the system developed by Waleh et al., 1982. Toxic concentrations were defined as those that produced a decrease in the number of his+ colonies, or a clearing in the density of the background lawn, or both.

The test substance was initially tested in the preincubation test at half-log dose intervals up to a dose that elicited toxicity, or to a dose immediately below one that was toxic in the preliminary toxicity procedure. Subsequent trials occasionally used narrower dose increments, and may not have included doses in the toxic range. At least 5 doses of the test substance were tested in triplicate, and repeat experiments were performed at least 1 week following the initial trial.

Concurrent solvent (dimethyl sulfoxide) and positive controls were run with each trial. The positive controls in the absence of exogenous metabolic activation were sodium azide (TA1535 and TA100), 9-aminoacridine (TA97 and TA1537), and 4-nitro-o-phenylenediamine (TA98). The positive control for exogenous metabolic activation with all strains was 2-aminoanthracene.

The test substance was considered mutagenic or weakly mutagenic if it produced a reproducible, dose-related response over the solvent control, under a single metabolic activation condition, in replicate trials. The test substance was considered questionable if the results of individual trials were not reproducible, if increases in his+ revertants did not meet the criteria for a weakly positive response, or if only single doses produced increases in his+ revertants in repeat trials. The test substance was judged nonmutagenic if it did not meet the criteria for a mutagenic or questionable response.

GLP: Unknown

Test Substance: 2-Methyl-3-butenenitrile, purity 82%

Results: Equivocal

Remarks: 2-Methyl-3-butenenitrile produced weakly mutagenic or equivocal results without exogenous activation in *Salmonella typhimurium* strain TA97.
2-Methyl-3-butenenitrile was nonmutagenic with or without exogenous activation in *Salmonella typhimurium* strains TA100, TA1535, TA98, TA1537, and with activation

strains TA100, TA1535, TA98, TA1537, and with activation in TA97.

Reference: Zeiger, E. et al. (1992). Environ. Mol. Mutagen., 19(Suppl. 21):2-141.

Haworth, S. et al., (1983). Environ. Mutagen., 6(Suppl. 1):3-142.

Waleh, N. S. et al. (1982). Mutat. Res., 97:247-256.

Reliability: High because a scientifically defensible or guideline method was used.

Additional References for *In vitro* Bacterial Reverse Mutation Studies:

Data from these additional sources support the study results summarized above. These studies were not chosen for detailed summarization because the data were not substantially additive to the database.

DuPont Co. (1978). Unpublished Data, Haskell Laboratory Report No. 751-78, "Mutagenic Activity in the *Salmonella*/Microsome Assay" (December 19).

DuPont Co. (1991). Unpublished Data, Haskell Laboratory Report No. 277-91, "Mutagenicity Testing of 2-Methyl-3-Butenenitrile in the *Salmonella typhimurium* Plate Incorporation Assay" (May 31).

DuPont Co. (1980). Unpublished Data, Haskell Laboratory Report No. 425-80, "Mutagenicity Evaluation in *Salmonella typhimurium*" (June 17).

Type: ***In vitro* Clastogenicity Studies:** No Data.

Type: ***In vivo* Studies:** No Data.

Appendix B

12 November 2002

ROBUST SUMMARY FOR 2-PENTENENITRILE

Existing published and unpublished data were collected and scientifically evaluated to determine the best possible study or studies to be summarized for each required endpoint. In the spirit of this voluntary program, other data of equal or lesser quality are not summarized, but are listed as related references at the end of each appropriate section, with a statement to reflect the reason why these studies were not summarized.

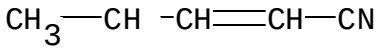
1.0 Substance Information

CAS Number: 13284-42-9 (2-Pentenenitrile)
25899-50-7 (cis-2-Pentenenitrile)
26294-98-4 (trans-2-Pentenenitrile)

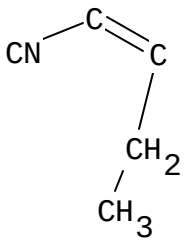
Chemical Name: 2-Pentenenitrile

Structural Formula:

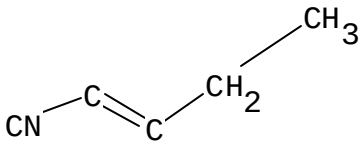
2-Pentenenitrile



cis-2-Pentenenitrile



trans-2-Pentenenitrile



Other Names:

<u>2-Pentenenitrile</u>

Pent-2-enenitrile
1-Cyano-1-butene

<u>cis-2-Pentenenitrile</u>

cis-2-Pentenonitrile
(Z)-Pent-2-enenitrile
2-Pentenenitrile, (Z)-
2-Pentenenitrile, (2Z)
2 PN-HP
cis-1-Cyano-1-butene
cis-1-butenyl cyanide

trans-2-Pentenenitrile

(E)-Pent-2-enenitrile
2-Pentenenitrile, (2E)-
2-Pentenenitrile, (E)-
trans-1-Butenyl cyanide
trans-2-Pentenonitrile

Exposure Limits: 0.3 ppm, 8- and 12-hour TWA; skin: DuPont Acceptable Exposure Limit (AEL) (cis-2-pentenenitrile)

2.0 Physical/Chemical Properties

2.1 Melting Point: Not Applicable.

2.2 Boiling Point

Value:	127°C
Decomposition:	No Data
Pressure:	No Data
Method:	No Data
GLP:	Unknown
Reference:	DuPont Co. (1998). Material Safety Data Sheet No. 6035CR (September 18).
Reliability:	Not assignable because limited study information was available.

Additional Reference for Boiling Point:

DuPont Co. (1981). DuPont Commodity Distribution Sheet.

2.3 Density

Value:	0.82
Temperature:	20°C
Method:	No Data
GLP:	Unknown
Results:	No additional data.
Reference:	DuPont Co. (1998). Material Safety Data Sheet No. 6035CR (September 18).
Reliability:	Not assignable because limited study information was available.

Additional Reference for Density:

DuPont Co. (1981). DuPont Commodity Distribution Sheet.

2.4 Vapor Pressure

Value:	4.05 mm Hg
Temperature:	25°C
Decomposition:	No Data
Method:	Estimated using the mean of Antoine & Grain methods.
GLP:	Not Applicable
Reference:	SRC MPBPWIN v1.40 in EPIWIN v3.05.
	Syracuse Research Corporation (MPBPWIN) program estimates the boiling point (at 760 mm Hg), melting point, and vapor pressure of organic compounds. The vapor pressure is estimated using the mean of the Antoine and Grain methods. A description of the methodology is detailed in:
	Antoine Method: Lyman, W. J. et al. (1990). Handbook of Chemical Property Estimation Methods, Chapter 14, American Chemical Society, Washington, DC.
	Modified Grain Method: Lyman, W. J. (1985). In: Environmental Exposure From Chemicals, Volume I, Chapter 2, Neely, W. B. and G. E. Blau (eds.), CRC Press, Inc., Boca Raton, FL.
Reliability:	Estimated value based on accepted model.

Additional References for Vapor Pressure:

DuPont Co. (1981). DuPont Commodity Distribution Sheet.

DuPont Co. (1998). Material Safety Data Sheet No. 6035CR (September 18).

2.5 Partition Coefficient (log Kow)

Value:	1.11
Temperature:	Not Applicable
Method:	Modeled. The KOWWIN computer program, version 1.66 from Syracuse Research Corporation, calculates the log octanol/water partition coefficient (log Kow) of organic chemicals using an atom/fragment contribution method.
GLP:	Not Applicable
Reference:	The methodology is described in the following journal article:
	Meylan, W. M. and P. H. Howard (1995). J. Pharm. Sci., 84:83-92.

84:83-92.

Reliability: Estimated value based on accepted model.

Additional References for Partition Coefficient (log Kow): None Found.

2.6 Water Solubility

Value: 7472 mg/L
Temperature: 22.5°C
pH/pKa: No Data
Method: Water solubility of the test substance was estimated by determining the total organic carbon in water to which an amount of test substance in excess of the water solubility had been added. Samples were tested for their solubility in water after 48 and 96 hours of continuous mixing. Approximately 200 mg of the test substance, prepared in quadruplicate replicates, was added to 20 mL of deionized water in a glass test vessel with a Teflon®-coated screw cap. Two of the replicates were mixed end-over-end for 48 hours and then analyzed. The other 2 replicates were mixed end-over-end for 96 hours before analysis. Prior to analysis, the test vessels were allowed to stand for 1 hour. The upper 5 mL layer of solution was removed by pipette and discarded to eliminate test substance at the top of the test vessel. Samples were analyzed for total carbon content via an analyzer with an autosampler attachment. Water solubility was determined by assuming that the test material contained 100% test substances.
GLP: No
Reference: DuPont Co. (2002). Unpublished Data, Report No. EMSER 005-02, "Estimated Water Solubility of cis-2-Pentenenitrile" (January 24).
Reliability: Medium because a suboptimal study design was used.

Value: 7930 mg/L
Temperature: 25°C
pH/pKa: No Data
Method: Modeled
GLP: Not Applicable
Reference: WsKow v1.40 EPIWIN v3.05 (SRC Database).

WsKow estimated the water solubility (WSol) of an organic compound using the compound's log octanol-water partition coefficient (log Kow). The following journal article describes the estimation methodology:

	Meylan, W. M. et al. (1996). Environ. Toxicol. Chem., 15:100-106.
Reliability:	Estimated value based on accepted model.

Additional References for Water Solubility:

DuPont Co. (1981). DuPont Commodity Distribution Sheet.

DuPont Co. (1998). Material Safety Data Sheet No. 6035CR (September 18).

2.7 Flash Point

Value:	26°C
Method:	Closed cup
GLP:	Unknown
Reference:	DuPont Co. (1998). Material Safety Data Sheet No. 6035CR (September 18).
Reliability:	Not assignable because limited study information was available.

Additional Reference for Flash Point:

DuPont Co. (1981). DuPont Commodity Distribution Sheet.

2.8 Flammability

Results:	Flammable
Method:	No Data
GLP:	Unknown
Reference:	DuPont Co. (1998). Material Safety Data Sheet No. 6035CR (September 18).
Reliability:	Not assignable because limited study information was available.

Additional Reference for Flammability:

DuPont Co. (1981). DuPont Commodity Distribution Sheet.

3.0 Environmental Fate

3.1 Photodegradation

Concentration:	Not Applicable
Temperature:	Not Applicable
Direct Photolysis:	Not Applicable
Indirect Photolysis:	Not Applicable

Breakdown

Breakdown Products:	Not Applicable
Method:	The AOP Program, version 1.90 from Syracuse Research Corporation, estimates the Atmospheric Oxidation Potential. The AOP program estimates the rate constant for the atmospheric, gas-phase reaction between photochemically produced hydroxyl radicals and organic chemicals. The methodology used by the Atmospheric Oxidation Program is based upon the structure-activity relationship (SAR) methods developed by Dr. Roger Atkinson and co-workers (Atkinson et al., 1987; 1995; 1996; 1984). The rate constant for the reaction of 2-pentenenitrile vapor with photochemically generated hydroxyl radicals in the atmosphere is estimated to be $1.0x10^{-11}$ cm^3/molecule-sec for the cis isomer and $1.1x10^{-11}$ cm^3/molecule-sec for the trans isomer at 25°C (SRC AOPWin v1.90). These values correspond to respective half-lives of 1.6 days and 1.4 days, assuming a 24 hour day and an ambient hydroxyl radical concentration of $0.5x10^6$ molecules/cm^3.
GLP:	Not Applicable
Reference:	Atkinson, R. et al. (1987). Intern. J. Chem. Kinet., 19:799-828. Atkinson, R. et al. (1995). Atmos. Environ., 29:1685-1695. Atkinson, R. et al. (1996). Environ. Sci. Technol., 30:329-334. Atkinson, R. et al. (1984). Chem. Rev., 84:437-470. The following journal article describes the AOP Program: Meylan, W. M. and P. H. Howard (1993). Chemosphere, 26:2293-9229.
Reliability:	Estimated value based on accepted model.

Additional References for Photodegradation: None Found.

3.2 Stability in Water

Concentration:	Not Applicable
Half-life:	The Henry's Law constant for 2-pentenenitrile is estimated to be $2.28x10^{-4}$ atm-m^3/mole (SRC HENRYWIN v3.10 in EPIWIN v3.05) from its estimated vapor pressure of 4.05 mm Hg (SRC MPBPWIN v1.40 in EPIWIN v3.05, mean of Antoine & Grain Methods) and water solubility of

	mean of Antoine & Grain Methods) and water solubility of 7930 mg/L (WsKow v1.40 EPIWIN v 3.05). The estimated volatilization half-life from a model river (1 m deep, flowing 1 m/sec, wind velocity of 5 m/sec) is approximately 3.2 hours. The estimated volatilization half-life from a model lake (1 m deep, flowing 0.05 m/sec, wind velocity of 0.5 m/sec) is approximately 4.6 days (EPIWIN v3.05).
% Hydrolyzed:	Not Applicable
Method:	Modeled. The WVOL program estimates the volatilization half-lives from a model river and lake using the methodology from Lyman et al., 1990 (adsorption to suspended solids and sediments is ignored). The user can input an experimental water solubility, vapor pressure, or Henry's Law constant or EPI will automatically estimate a Henry's Law Constant from SRC's Henry program for this calculation. WsKow estimates the water solubility (WSol) of an organic compound using the compounds log octanol/water partition coefficient (log Kow).
GLP:	Not Applicable
Reference:	Lyman, W. J. et al. (1990). The Handbook of Chemical Property Estimation Methods, American Chemical Society, Washington DC. The following journal article describes the estimation methodology: Meylan, W. M. et al. (1996). Environ. Toxicol. Chem., 15:100-106.
Reliability:	Estimated value based on accepted model.

Additional References for Stability in Water: None Found.

3.3 Transport (Fugacity)

Media:	Air, Water, Soil, and Sediments	
Distributions:	Air:	10.8%
	Water:	46.3 %
	Soil:	42.8%
	Sediments:	0.1%
Half-life:	Air:	36.6 hours
	Water:	360 hours
	Soil:	720 hours
	Sediment:	3240 hours
Adsorption Coefficient:	Not Applicable	
Desorption:	Not Applicable	

Volatility:	Not Applicable
Method:	Calculated according to Mackay, Level III, Syracuse Research Corporation EPIWIN version 3.05. Emissions (1000 kg/hr) to air, water, and soil compartments using standard EPA model defaults with BIOWIN half-life factors of water, 1; soil, 2; and sediments, 9.
	Data Used: Molecular Weight: 81.12 Henry's Law Constant: 2.28×10^{-4} atm-m^3/mole (HenryWin Program) Vapor Pressure: 4.05 mm Hg (MPBPWIN v1.40) Log Kow: 1.11 (KowWin Program) Soil Koc: 5.28 (Log Kow estimate)
GLP:	Not Applicable
Reference:	Syracuse Research Corporation EPIWIN v3.05 contains a Level III fugacity model. The methodology and programming approach were developed by Dr. Donald MacKay and coworkers and are detailed in: Mackay, D. (1991). Multimedia Environmental Models: The Fugacity Approach, pp. 67-183, Lewis Publishers, CRC Press. Mackay, D. et al. (1996). Environ. Toxicol. Chem., 15(9):1618-1626. Mackay, D. et al. (1996). Environ. Toxicol. Chem., 15(9):1627-1637.
Reliability:	Estimated value based on accepted model.

Additional References for Transport (Fugacity): None Found.

3.4 Biodegradation:

Value:	3% after 28 days (Not Readily Biodegradable)
Breakdown Products:	No Data
Method:	The procedure used in the test were based on the recommendations of the following guidelines: OECD Guideline 301B. The biodegradability of cis-2-pentenenitrile was tested using the Modified Sturm test. Biodegradability was measured as CO_2 evolution. A test substance is considered "Readily Biodegradable" if it demonstrates a "pass level" of

	"Readily Biodegradable" if it demonstrates a "pass level" of 60% biodegradability within a 10-day window after exceeding the 10% level of biodegradability. A test substance is considered "Ultimately Biodegradable" if it demonstrates a "pass level" of 60% biodegradability, but not within a 10-day window after exceeding the 10% level of biodegradability. cis-2-Pentenenitrile reached a peak of 3% biodegradability at day 28, and therefore is regarded as not "Readily Biodegradable." cis-2-Pentenenitrile was not inhibitory to microorganisms in the inoculum.
GLP:	No
Reference:	DuPont Co. (2001). Unpublished Data, Report No. EMSE-073-01, "Biodegradability of cis-2-Pentenenitrile using the Modified Sturm Test (OECD 301B)" (December 17).
Reliability:	High because a scientifically defensible or guideline method was used.

Additional References for Biodegradation: None Found.

3.5 Bioconcentration

Value:	BCF=1.44. This BCF value suggests that bioconcentration potential in aquatic organisms is low.
Method:	The bioconcentration factor is calculated by Syracuse Research Corporation's BCFWIN Computer Program, version 2.14, which utilizes a linear regression based on the log Kow for the compound.
GLP:	Not Applicable
Reference:	The estimation methodology used by BCFWIN is described in the following document prepared for the U.S. Environmental Protection Agency (OPPT): "Improved Method for Estimating Bioconcentration Factor (BCF) from Octanol-Water Partition Coefficient," SRC TR-97-006 (2nd Update), July 22, 1997; prepared for Robert S. Boethling, EPA-OPPT, Washington, DC, Contract No. 68-D5-0012; prepared by William M. Meylan, Philip H. Howard, Dallas Aronson, Heather Printup, and Sybil Gouchie, Syracuse Research Corp., Environmental Science Center, 6225 Running Ridge Road, North Syracuse, NY 13212.
Reliability:	Estimated value based on accepted model.

Additional References for Bioconcentration: None Found.

4.0 Ecotoxicity

4.1 Acute Toxicity to Fish:

Type:	**96-hour LC_{50}**
Species:	*Pimephales promelas* (fathead minnow)
Value:	316 mg/L (95% confidence interval, 100-1000 mg/L)
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used that was consistent with OECD Guideline 203, with the following exceptions: 10x dose spacing, 4 test concentrations, and nominal test concentrations were reported. The acute toxicity to fathead minnows was determined in an unaerated, 96-hour static test. The nominal concentrations of cis-2-pentenenitrile used were 0, 1, 10, 100, and 1000 mg/L at a mean temperature of 21.3°C. One test chamber was used per test concentration with 10 test organisms in each chamber. Analysis of the test and control solution samples for dissolved oxygen and pH were made at test initiation (0 hours) and test completion (96 hours).
GLP:	No
Test Substance:	cis-2-Pentenenitrile, purity 98.77%
Results:	Based on visual observations, the water control and all test concentrations were clear and colorless at test start. No precipitate was observed. All water quality parameters were within acceptable limits during the exposure. At test initiation (0 hours), dissolved oxygen and pH ranged from 8.8-8.9 and 7.1-7.5, respectively. Dissolved oxygen and pH ranged from 6.0-6.5 and 7.2-7.3, respectively, at test completion (96 hours) for all concentrations except 1000 mg/L. Dissolved oxygen and pH for the 1000 mg/L concentration were measured at 24 hours due to total mortality, and were 5.4 and 7.2, respectively. Exposure of fathead minnows to 1, 10, 100, and 1000 mg/L cis-2-pentenenitrile resulted in 0, 0, 0, and 100% mortality, respectively, at the end of 96 hours. No mortality or sublethal effects were observed in the control organisms.
Reference:	DuPont Co. (2000). Unpublished Data, Haskell Laboratory Report No. DuPont-5277, "Static, Acute, 96-Hour Screening Test to *Pimephales promelas*" (December 20).
Reliability:	Medium because a suboptimal study design was used (nominal test concentrations).

Additional References for Acute Toxicity to Fish: None Found.

4.2 Acute Toxicity to Invertebrates:

Type:	**48-hour EC_{50}**
Species:	*Daphnia magna* (water flea)
Value:	114 mg/L (95% confidence interval, 77-276 mg/L)
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used that was consistent with OECD Guideline 202, with the following exceptions: 10x dose spacing, 4 test concentrations, nominal test concentrations were reported, and 1 replicate per test concentration was performed. The acute toxicity to *Daphnia magna* (less than 24 hours old) was determined in an unaerated, 48-hour static test. The nominal concentrations of cis-2-pentenenitrile used were 0, 1, 10, 100, and 1000 mg/L at a mean temperature of 20.1°C. One test chamber was used per test concentration with 10 test organisms in each chamber. Analysis of the test and control solution samples for dissolved oxygen and pH were made at test initiation (0 hours) and test completion (48 hours).
GLP:	No
Test Substance:	cis-2-Pentenenitrile, purity 98.77%
Results:	Based on visual observations, the water control and all test concentrations were clear and colorless at test start. No precipitate was observed. All water quality parameters were within acceptable limits during the exposure. At test initiation (0 hours), dissolved oxygen was 8.6 and pH ranged 6.9-7.8. At test completion, dissolved oxygen and pH ranged from 7.8-7.9 and 7.6-8.0, respectively. Exposure of daphnids to 1, 10, 100, and 1000 mg/L cis-2-pentenenitrile resulted in 0, 10, 40, and 100% immobility, respectively, at the end of 48 hours. No immobility or sublethal effects were observed in the control organisms.
Reference:	DuPont Co. (2000). Unpublished Data, Haskell Laboratory Report No. DuPont-5278, "Static, Acute, 48-Hour Screening Test to *Daphnia magna*" (December 20).
Reliability:	Medium because a suboptimal study design was used (nominal test concentrations).

Additional References for Acute Toxicity to Invertebrates: None Found.

4.3 Acute Toxicity to Aquatic Plants:

Type:	**72-hour EC_{50}**
Species:	*Selenastrum capricornutum* (green alga)
Value:	263.5 mg/L (95% confidence interval, 86.8-113.4 mg/L)
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used that was consistent with OECD Guideline 201. Algae were exposed to nominal concentrations of 0, 0.01, 0.1, 1, 10, 100, and 1000 mg/L cis-2-pentenenitrile. After addition of algal cells, the test and control flasks were placed on a shaker table in a chamber with a temperature of approximately 25°C. The algae were incubated for 72 hours without medium renewal. Illumination was supplied by cool-white fluorescent tubes (mean light intensity of 7334 lumens/m^3). The shaking speed was 90 revolutions per minute (rpm). The effect was expressed as percent inhibition growth based on healthy cell count (also referred to as cell density) relative to the control.
GLP:	No
Test Substance:	cis-2-Pentenenitrile, purity 98.77%
Results:	Based on visual observations, the control and all test concentration solutions were clear and had no color before addition of algal cells. The pH of the culture medium at study start was 7.45, and the pH of the test solutions at study start was 6.88-7.45, and at test termination was 7.00-7.28. The NOEC was 100 mg/L.
Reference:	DuPont Co. (2000). Unpublished Data, Haskell Laboratory Report No. DuPont-5279, "Influence on Growth and Growth Rate of the Green Alga *Selenastrum capricornutum*" (November 29).
Reliability:	Medium because a suboptimal study design was used (nominal test concentrations).

Additional References for Acute Toxicity to Aquatic Plants: None Found.

5.0 Mammalian Toxicity

5.1 Acute Toxicity

Type:	**Oral ALD**
Species/strain:	Male rats/Crl:CD®BR
Value:	450 mg/kg

Method:	No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study. Male rats (1/dose level), approximately 7 weeks old upon arrival, were administered 130, 200, 300, 450, 670, 1000, or 2300 mg/kg cis-2-pentenenitrile dispersed in corn oil via intragastric intubation. Following administration of the test substance, rats were observed for clinical signs of toxicity. Surviving rats were weighed daily and observed daily until signs of toxicity subsided, and then at least 3 times/week throughout a 14-day post-exposure period. Observations for mortality were made daily throughout the study.
GLP:	Yes
Test Substance:	cis-2-Pentenenitrile, purity 98.6%
Results:	Mortality occurred at doses =450 mg/kg. Deaths occurred up to 2 days after dosing. The rat dosed at 130 mg/kg exhibited no clinical signs of toxicity. Clinical signs of toxicity observed at lethal doses included hyperactivity, spasms, incoordination (450 mg/kg); lethargy (≥670 mg/kg); and clear ocular discharge (2300 mg/kg). Clinical signs of toxicity observed within the 1st 2 days after dosing at non-lethal doses included hyperactivity, tremors, spasms, and incoordination (200 and 300 mg/kg). Moderate to severe weight losses (up to 20% of initial body weight) were observed up to 2 days after dosing.
Reference:	DuPont Co. (1990). Unpublished Data, Haskell Laboratory Report No. 197-90, "Approximate Lethal Dose (ALD) of 2-Pentenenitrile in Rats" (May 17) (also cited in TSCA fiche OTS0000790).
Reliability:	High because a scientifically defensible or guideline method was used.

Additional References for Acute Oral Toxicity:

Data from these additional sources support the study results summarized above. These studies were not chosen for detailed summarization because the data were not substantially additive to the database.

DuPont Co. (1976). Unpublished Data, Haskell Laboratory Report No. 35-76, "Acute Oral Test" (January 21) (also cited in TSCA fiche OTS0000790 and OTS0571588).

DuPont Co. (1976). Unpublished Data, Haskell Laboratory Report No. 36-76, "Acute Oral Test" (January 21) (also cited in TSCA fiche OTS0000790 and OTS0571643).

DuPont Co. (1975). Unpublished Data, Haskell Laboratory Report No. 409-75, "Acute Oral Test" (July 11) (also cited in TSCA fiche OTS0529919).

Dow Chemical Co. (1983). R & D Report (March 1) (TSCA fiche OTS0537162).

Data from these additional sources were not summarized because the study design was not adequate.

Tanii, H. et al. (1989). Neurotoxicology, 10:157-166.

Tanii, H. et al. (1991). Neuropharmacology, 30(8):887-892 (TOXLINE/1992/44421).

Type:	**Inhalation LC_{50}**
Species/Strain:	Male and female rats/CRL:CD®BR
Exposure Time:	4 hours
Value:	850 ppm (95% confidence interval, 740-970 ppm)
Method:	The procedures used in the test were based on the recommendations of the following guideline:

U.S. EPA Health Effects Testing Guidelines 40 CFR.798.1150.

Groups of young adult male and female rats (5/sex/dose level), approximately 7 weeks of age upon arrival, were exposed nose-only to 18, 140, 650, 900, or 1200 ppm cis-2-pentenentrile. The male rats weighed 240-299 g, and female rats weighed 175-235 g on the day of exposure. Rats were observed for mortality and clinical signs of toxicity immediately after they were removed from the restrainers following exposure, and during a 14- or 28-day post-exposure period. The 14-day recovery period was extended to 28 days for rats exposed to 140, 650, 900, or 1200 ppm cis-2-pentenenitrile due to the persistence of clinical signs. In addition, body weights were recorded. At the end of the recovery period, all surviving rats were euthanized without patholological evaluation.

During exposure, rats were restrained in perforated, polycarbonate cylinders with conical nose pieces. The restrainers were inserted into the face plate of a 29-L cylindrical glass exposure chamber so that only the nose of each rat protruded into the chamber. Atmospheres of cis-2-pentenenitrile were generated by vaporization of the test substance in a stream of filtered air heated to 100ºC. The test substance was metered into a J-shaped glass tube

The test substance was metered into a J-shaped glass tube containing glass beads with an infusion pump. Chilled, filtered dilution air was added to the heated air/test substance mixture. The generation train then fed into a 29-L glass exposure chamber with a baffle positioned in the air stream to aid in the distribution of the test substance within the chamber. The atmospheric concentration of cis-2-pentenenitrile vapor was determined during each exposure. Chamber airflow was set initially for the exposure and maintained at a constant rate throughout the 4-hour exposure. Generation and dilution airflows were set and monitored. Chamber temperature, relative humidity, and oxygen concentration were measured.

The LC_{50} was determined using probit analysis.

GLP: Yes

Test Substance: cis-2-Pentenenitrile, purity 98.6%

Results: The mean total vapor concentrations were 18, 140, 650, 900, and 1200 ppm. During the animal exposures, the total airflow was held constant at 35 L/min and chamber temperatures ranged from 23-28ºC. The relative humidity in the test chamber ranged from 21-58%, and chamber oxygen was 21%. A study of the chamber distribution of vapor was performed. The vapor was considered to be homogeneously distributed at a design concentration of 1000 ppm cis-2-pentenenitrile.

Mortality was 0/10, 0/10, 0/10, 8/10, and 9/10 at 18, 140, 650, 900, and 1200 ppm, respectively. The majority of the rats died within 1-2 days following exposure, with the exception of one female rat exposed at 900 ppm that died 4 days following exposure. There were no sex-related differences in the response of rats in this study based on the lethality.

Clinical signs of toxicity could not be assessed during exposure because the method of restraint prevented clear visual observation of the rats. During exposures, tapping on the chamber elicited a response from all rats. Upon removal of the rats from restrainers immediately following exposures, clinical observations included nasal and oral discharges. Wet perineum and wet back were also observed, but are a common finding associated with the method of restraint used in this study. Males exposed at 18 ppm showed nasal discharges, and in 1 rat ocular discharge following exposure. No clinical signs were observed in females exposed at this level. Clinical observations that were observed, but were not

level. Clinical observations that were observed, but were not common in rats exposed at higher concentrations included muscle fasciculation, shut eye(s), moribundity, and exophthalmus. Clinical observations noted in rats following exposure at levels producing lethality (900 or 1200 ppm) included irregular respiration, immobility, and lethargy.

A number of clinical signs that were observed were suggestive of central nervous system effects. These included abnormal gait and mobility, ataxia, hyperreactivity, hypersensitivity, tremors, forward circling, backward circling, splaying of the feet, bobbing of the head, vocalizations, chattering of the teeth, rolling behavior, wobbling behavior, and walking backward. Effects such as abnormal gait, ataxia, circling behavior, head bobbing movement, vocalizations, and tremors were noted in non-lethal levels as low as 140 ppm. Many of these effects appeared reversible within 1-4 days following exposure. However, abnormal gait and mobility, circling behaviors, splaying of the feet, and head bobbing movement were observed throughout the 28-day recovery period in rats exposed at concentrations of 650 ppm or greater. These clinical signs, when present in rats exposed at 140 ppm, were not as persistent as in rats exposed at levels greater than 140 ppm. Other clinical signs noted during the recovery period included alopecia, lung noise, weakness, and stained perineum.

By the 1st day following exposure, most rats exhibited weight loss. Male rats exposed to 18 ppm cis-2-pentenenitrile lost from 2-4% of their initial body weight, while females lost from 0.3-4% of their initial body weight. At higher concentrations (exposures =140 ppm), male rats lost from 10-17% and females lost 4-14% of their initial body weight. Generally, all rats gained weight over the recovery period, but surviving rats exposed at all levels experienced some periods of transient body weight loss throughout the recovery period.

Reference: DuPont Co. (1991). Unpublished Data, Haskell Laboratory Report No. 75-91, "Acute Inhalation Toxicity Study with cis-2-Pentenenitrile in Rats (June 5) (also cited in TSCA fiche OTS0529919).

Reliability: High because a scientifically defensible or guideline method was used.

Additional References for Acute Inhalation Toxicity:

Data from these additional sources support the study results summarized above. These studies were not chosen for detailed summarization because the data were not substantially additive to the database.

DuPont Co. (1976). Unpublished Data, Haskell Laboratory Report No. 42-76, "Acute Inhalation Toxicity" (January 21) (also cited in TSCA fiche OTS0000790).

DuPont Co. (1976). Unpublished Data, Haskell Laboratory Report No. 43-76, "Acute Inhalation Toxicity" (January 21) (also cited in TSCA fiche OTS0000790 and OTS0571587).

U. S. EPA (n.d.). EPSAR 8EHQ-1190-1121 (RTECS/SB2260000).

Data from this additional source were not summarized because the study design was not adequate.

DuPont Co. (1993). Unpublished Data, Haskell Laboratory Report No. 253-93, "Acute Inhalation Neurotoxicity Study in Rats" (December 3).

Type:	**Dermal ALD**
Species/Strain:	Male rabbits/Albino
Exposure Time:	24 hours
Value:	300 mg/kg
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study. Male rabbits (1/dose level) were clipped free of hair over the back and trunk area and fitted with plastic collars. They were dosed with 60, 90, 130, 200, 300, 450, 670, 1500, 2500, or 4000 mg/kg cis-2-pentenenitrile at 67.7% or 37.4%. The rabbits were treated by applying the test material to gauze pads, then wrapped successively with plastic wrap, stretch gauze and elastic adhesive bandage. Wrappings were removed from surviving animals after 24 hours, and the animals were observed for 14 days.
GLP:	No
Test Substance:	cis-2-pentenenitrile, purity 67.7% or 37.4%
Results:	Deaths occurred at 300 mg/kg and above. All deaths occurred within 5 hours after dosing. Clinical signs at lethal doses included dilated pupils, static ataxia, tremors, prostration, and tonic then clonic convulsions. Clinical signs observed at non-lethal doses included dilated pupils, static ataxia, and tremors. The clinical signs returned to normal in

	ataxia, and tremors. The clinical signs returned to normal in all surviving animals within 24-48 hours.
Reference:	DuPont Co. (1976). Unpublished Data, Haskell Laboratory Report No. 78-76, "Skin Absorption Approximate Lethal Dose (ALD) on Rabbits (February 5) (also cited in TSCA fiche OTS0000790 and OTS0571460)
Reliability:	High because a scientifically defensible or guideline method was used.

Additional References for Acute Dermal Toxicity:

Data from these additional sources support the study results summarized above. These studies were not chosen for detailed summarization because the data were not substantially additive to the database.

DuPont Co. (1983). Unpublished Data, Haskell Laboratory Report No. 65-83, Acute Skin Absorption LD_{50} Test on Rabbits (March 1) (also cited in TSCA fiche OTS0000790).

Dow Chemical Co. (1983). R & D Report (March 1) (TSCA fiche OTS0537162).

Data from this additional source were not summarized because the focus of the study was to determine if the test substance was a Class B poison.

DuPont Co. (1983). Unpublished Data, Haskell Laboratory Report No. 543-83, "Class B Poison Test on Rabbit Skin" (December 7) (also cited in TSCA fiche OTS0529919).

Type:	**Dermal Irritation**
Species/Strain:	Female rabbits/New Zealand White
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study. On the day prior to study initiation, the hair of 6 female rabbits was closely clipped to expose the skin from the scapular to the lumbar region of the back. The rabbit's body weights ranged from 2978-3169 g on the day of treatment. Each rabbit was placed into a stock that had been fitted with a piece of rubber sheeting. The rabbits remained in the stocks throughout the exposure period and during that time did not have access to food or water. Approximately 0.5 mL of 2-pentenenitrile was applied directly on the test site beneath a gauze square that was held in place with non-irritating tape. The rubber sheeting was then wrapped around the animal and secured with clips to retard evaporation and to keep the test material in contact with the

evaporation and to keep the test material in contact with the skin without undue pressure.

Approximately 24 hours after application of the test substance, the rubber sheeting was loosened, and the skin at the corners of the gauze squares was marked with a waterproof pen; wrappings and gauze squares were then removed. The test sites were gently washed with warm water to remove excess test substance. The skin was gently patted dry, and the animals were returned to their cages.

Approximately 24 and 48 hours after application of the test substance, the test sites were evaluated for erythema, edema, and other evidence of dermal effects, and were scored according to the Draize scale. The adjacent areas of the untreated skin were used for comparison.

GLP: Yes

Test Substance: cis-2-Pentenenitrile, purity 98.6%

Results: No dermal irritation was observed in any of the animals throughout the study. Under conditions of this study, 2-pentenenitrile was not a skin irritant.

Reference: DuPont Co. (1990). Unpublished Data, Haskell Laboratory Report No. 152-90, "Skin Irritation Test with 2-Pentenenitrile in Rabbits" (April 20) (also cited in TSCA fiche OTS0529919).

Reliability: High because a scientifically defensible or guideline method was used

Additional Reference for Dermal Irritation:

Data from this additional source were not summarized because insufficient study information was available.

Dow Chemical Co. (1983). R & D Report (March 1) (TSCA fiche OTS0537162).

Type: **Dermal Sensitization:** No Data.

Type: **Eye Irritation**

Species/Strain: Female rabbits/New Zealand White

Method: No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study.

On the day of study initiation, the eyes of 2 female rabbits were examined using illumination, magnification, and fluorescein dye. The animals were selected based on no evidence of preexisting corneal or conjunctival injury or

	evidence of preexisting corneal or conjunctival injury or irritation. The rabbits were approximately 17 weeks old and weighed 3048 and 2889 g, respectively, on the day of treatment. Approximately 0.01 mL of 2-pentenenitrile was introduced into the lower conjunctival sac of each left eye of 2 rabbits. The right eye was not treated and served as a control. The treated and control eyes of 1 rabbit remained unwashed. Approximately 20 seconds after the test material was administered, both eyes of the remaining rabbit were rinsed for approximately 1 minute with water at room temperature. Each rabbit was observed for approximately 30-60 seconds before being returned to its cage, and any abnormal behavior was noted. Approximately 1 and 4 hours, and 1, 2, and 3 days after the test substance was administered, the rabbits were examined for evidence of eye irritation. At each of these observation periods, eyes were examined using illumination and magnification, and scored for ocular reactions using the Draize scale. Eyes were also observed for any unusual responses to treatment such as pannus, blistering of the conjunctiva, ulceration, or other effects indicative of corrosive action. Reagent strips were used to detect occult blood in discharge from the eye. Biomicroscopic and fluorescein stain examinations were also conducted at post-treatment days 1, 2, and 3. Control eyes were not scored.
GLP:	Yes
Test Substance:	cis-2-Pentenenitrile, purity 98.6%
Results:	2-Pentenenitrile produced moderate conjunctival redness and minimal blood-tinged discharge in the treated washed eye. No irritation was observed in the eye that was washed after treatment. Fluorescein stain was negative for corneal injury, and biomicroscopic examinations revealed no corneal injury in both treated eyes throughout the study. The unwashed eye was normal by 2 days after treatment. Under the conditions of this study, 2-pentenenitrile was a moderate eye irritant.
Reference:	DuPont Co. (1990). Unpublished Data, Haskell Laboratory Report No. 158-90, "Eye Irritation Test with 2-Pentenenitrile in Rabbits" (April 11) (also cited in TSCA fiche OTS0529919).
Reliability:	High because a scientifically defensible or guideline method was used.

Additional Reference for Eye Irritation:

Data from this additional source support the study results summarized above. This study was not chosen for detailed summarization because the data were not substantially additive to the database.

Dow Chemical Co. (1983). R & D Report (March 1) (TSCA fiche OTS0537162).

5.2 Repeated Dose Toxicity

Type:	**28-Day Oral Toxicity**
Species/Strain:	Rats/CRL:CD®(SD)IGS BR
Sex/Number:	Male and female/20 per sex per dose level for the 0 and 75 mg/kg dose groups; 10/sex/dose level for the 10 and 30 mg/kg dose groups
Exposure Period:	All male rats: 28 days (2 month recovery for 10 rats from the 0 and 75 mg/kg dose levels) Female rats designated for subchronic toxicity: 29 days Female rats designated for recovery: 28 days (2 month recovery)
Frequency of Treatment:	Daily
Exposure Levels:	0, 10, 30, 75 mg/kg/day (dosage lowered from 100 mg/kg to 75 mg/kg on test day 8)
Method:	The procedures used in the test were based on the recommendations of the following guideline: OECD Guideline 407. The test substance was administered to male rats for 28 days and female rats for 29 days (females). All groups contained 10 rats/sex/group for evaluation of subchronic toxicity. Control and high-dose groups contained an additional 10 rats/sex/group for evaluation of recovery from test substance-related effects, following a 2-month recovery period. The high-dose group was reduced on test day 8 from 100 mg/kg to 75 mg/kg, due to mortality and moribundity in rats exposed to 100 mg/kg. For the remainder of the information listed here, this group will be referred to as 75 mg/kg. Samples containing the test substance at all concentrations were collected on test day 0. These samples were analyzed to determine concentration verification and stability. Samples containing the test substance at all concentrations

Samples containing the test substance at all concentrations were collected on test days 14 and 28. These samples were analyzed to determine concentration verification. All dosing solution samples were collected on the same day the solutions were prepared.

Body weights and detailed clinical observations were recorded weekly during the first week of dosing and during the recovery phase, and twice a week during the rest of the dosing phase. In addition, rats designated for neurobehavioral evaluations were weighed on the days of those evaluations. Food consumption was measured weekly.

Ophthalmologic examinations were conducted by a veterinary ophthalmologist. Both eyes were examined by focal illumination and indirect ophthalmoscopy. The examinations were conducted under subdued lighting after mydriasis was produced with a 1% tropic amide solution. On test day –6, the initial examination was performed on all rats received for the study. All surviving rats were examined on test day 22 (near the end of the exposure phase) and on test day 85 (near the end of the recovery phase).

The neurobehavioral groups were given functional observational battery (FOB) assessments (encompassing approximately 37 endpoints) and motor activity (MA) evaluations (encompassing 2 dependent variables) prior to the initiation of exposures, approximately 4 weeks after initiation of dosing, and near the end of the 2-month recovery phase.

Clinical pathology evaluation was conducted on 10 males and females per dose level on the day of necropsy, test day 28 (males) or test day 29 (females). The rats were fasted overnight (approximately 16 hours) and urine was collected over this interval. Each sample was analyzed or examined for 12 urine parameters.

Blood samples were collected from the same 10 rats/sex/level on the day of necropsy and 14 hematological parameters and 18 clinical chemistry parameters were measured or calculated.

After 28 days (males) or 29 days (females) on study, all surviving rats designated for the subchronic toxicity evaluation were sacrificed and examined for gross and histopathological changes. Rats from the control and

histopathological changes. Rats from the control and high-dose groups designated for recovery were sacrificed after an additional 2 months. The spleen, heart, thymus, liver, kidneys, brain, adrenal glands, testes and epididymides (males), and ovaries and uterus (females) were weighed at necropsy. Each rat was given a gross examination and approximately 50 tissues were saved for microscopic examination. All collected tissues from all animals in the control (0 mg/kg) and high concentration (75 mg/kg) groups were processed and received a full histopathological examination (including prostate, testes, epididymides, seminal vesicles, mammary gland, ovaries, and uterus). Target organs (nose, eyes, liver [females only], spleen, and testes) and most gross lesions were examined from rats in the low (10 mg/kg) and intermediate concentration (30 mg/kg) exposure groups, and from the recovery animals that were sacrificed by design.

Selected neuropathology evaluation was performed on all recovery animals (up to 10/sex/group) in the control and high dose groups, at the end of the recovery period. Based upon in-life evaluations, the sciatic, tibial, and sural nerves were the only neuropathology tissues evaluated.

Body weights, body weight gains, food consumption, food efficiency, and organ weight data were analyzed by one of the 2 following methods: (1) A test for lack of trend was performed. If the preliminary test was not significant a sequential application of the Jonckheere-Terpstra trend test was used. If the preliminary test was significant, preliminary tests for pairwise comparison were used. (2) The Levene's test for homogeneity and Shapiro-Wilk test for normality were performed as a preliminary test. If the preliminary test was not significant, a one-way analysis of variance followed with Dunnett's test was used. If the preliminary test was significant, the Kruskal-Wallis test followed with Dunn's test was used.

Motor activity was analyzed in a preliminary test using the Levene's test for homogeneity and Shapiro-Wilk test for normality. If the preliminary test was not significant, repeated measures analysis of variance followed by linear contrasts was used. If the preliminary test was significant, sequential application of the Jonckheere-Terpstra trend test was used.

Grip strength and foot splay were analyzed in a preliminary test using Bartlett's test for homogeneity of variances. If the preliminary test was not significant the one-way analysis of variance followed with Dunnett's test was employed. If the preliminary test was significant, the Kruskal-Wallis test followed with Dunn's test was used.

Clinical pathology data was analyzed in a preliminary test using Levene's test for homogeneity and Shapiro-Wilk test for normality. If the preliminary test was not significant, the one-way analysis of variance followed with Dunnett's test was used. If the preliminary test was significant the Kruskal-Wallis test followed with Dunn's test was used.

Incidence of detailed clinical observations and FOB descriptive parameters were analyzed using the Cochran-Armitage test for trend.

GLP: Yes

Test Substance: cis-2-Pentenenitrile, purity 98.77136 (area %)

Results: Analysis of the dosing solutions indicated that the test substance was present at the expected concentration at all dosage levels, and was stable in water under relevant storage conditions.

Survival was reduced in high-dose males. Three males died during the 1st week of the study, when they received 100 mg/kg/day. The deaths were considered compound related. A 4th male from this group died during recovery; the death was considered possibly compound related. No deaths occurred in females.

Compound-related reductions (compared to control) in mean body weight, body weight gain, and food consumption were observed in male and female rats dosed with 10, 30, or 75 mg/kg/day. Mean food efficiency was reduced in male and female rats dosed with 30 or 75 mg/kg/day. Male and female high-dose rats had mean body weight loss over the first week of dosing, when rats were dosed with 100 mg/kg/day. After the dosage was reduced to 75 mg/kg/day, high-dose rats gained weight, but at a lower rate than control rats. The dose-response for the body weight and nutritional effects demonstrated a similar pattern in males and females, but effects from each dose were generally less severe in females than in males. During recovery, the effects were reversed in both sexes, although mean body weight did not recover completely to control levels. Males demonstrated greater reversal than females.

levels. Males demonstrated greater reversal than females.

No compound-related clinical signs of toxicity were observed in rats dosed at 10 or 30 mg/kg. Compound-related clinical signs observed in male and female rats at 100/75 mg/kg included corneal or eye opacity/opaque, head tilt/bob/shake, hyperactivity, hyperreactivity, abnormal gait, and/or circling. The abnormal neurobehavioral signs were mainly observed when the rats were dosed with 100 mg/kg/day, or soon after the dose was reduced to 75 mg/kg/day. None of these neurobehavioral signs was observed during the functional observational battery (FOB) near the end of the dosing phase. The eye opacities observed during detailed clinical observations generally correlated with corneal opacity, keratitis, or uveitis observed during the ophthalmologic examination, with blue haze on the cornea observed during the FOB, and with histopathologic evidence of corneal degeneration. Most of the corneal/eye opacities were resolved after the dose was lowered, prior to the ophthalmologic examination, FOB, and microscopic evaluation. This is reflected in a lower incidence of eye effects observed during these examinations, compared to the incidence during detailed clinical observations.

Neurobehavioral evaluations at the end of the dosing phase demonstrated compound-related effects in the high-dose group, including reductions in forelimb and hindlimb grip strength and motor activity, and increases in the incidence of curled posture or sleeping in the home cage. Reductions in hindlimb grip strength were also observed in rats exposed to 30 mg/kg/day or 10 mg/kg/day (females only). Reduction in hindlimb grip strength was still present in high-dose females at the end of the recovery phase, although the effects were partially reversed. The reductions in grip strength are likely due to the lower body weight gain. No compound-related neuropathology was observed in rats evaluated at the end of the recovery phase.

There were no toxicologically significant effects on coagulation, clinical chemistry, or urinalysis parameters. Compound-related decreases in red cell mass parameters, accompanied by reticulocytosis, were observed in high-dose females at the end of the dosing phase, and were considered adverse. Increased pigment and hematopoiesis were observed in the spleen and were considered to be non-adverse markers for the hematology effects. No adverse clinical pathology effects were observed in recovery female rats or in male rats at either evaluation time.

rats or in male rats at either evaluation time.

Compound-related degeneration/atrophy of the dorsal olfactory mucosa, sometimes associated with submucosal fibrosis and degeneration of subjacent olfactory nerve fibers, was observed in all groups dosed with the test substance. Lesion incidence and severity were greatest in the 75 mg/kg/day males and females, slightly less in the 10 mg/kg/day males and females, and least in the 30 mg/kg/day males and females. The explanation for the non-monotonic dose-response for this lesion was not determined. Other toxicology endpoints did not demonstrate a similar pattern and the procedures used in dose solution preparation and dosing supported that all rats received the proper dosage of test substance. The nasal lesions observed at the end of the dosing phase were still present in rats after a 2-month recovery period. Metaplasia of olfactory mucosa to respiratory mucosa, considered to be a reparative process, was also present in recovery rats. Therefore, the nasal effects did not demonstrate reversal. Minimal spermatid retention was observed in testes of males dosed at 75 m/kg. This lesion was considered adverse but was reversible.

Under the conditions of this study, there is no no-observed-effect level (NOEL) for repeated-dose toxicity of the test substance in male or female rats. This lack of a NOEL is based on compound-related reductions in body weight and nutritional parameters, reductions in hindlimb grip strength (females only), and degeneration/atrophy of nasal dorsal olfactory mucosa in male and female rats dosed with 10 mg/kg/day and above. The in-life parameters in high-dose rats were more severe during the week the rats were dosed with 100 mg/kg/day, and demonstrated some recovery when the dosage was reduced to 75 mg/kg/day. Most parameters demonstrated at least partial reversal over the 2-month recovery phase; however, nasal histopathology did not demonstrate reversal.

Reference: DuPont Co. (2001). Unpublished Data, Haskell Laboratory Report No. DuPont-5496, "Repeated-Dose Oral Toxicity 28-Day Gavage Study in Rats" (October 23).

Reliability: High because a scientifically defensible or guideline method was used.

Type:	**4-Week Inhalation Neurotoxicity**
Species/Strain:	Rats/CRL:CD®BR
Sex/Number:	Male and female/15 per sex per dose level
Exposure Period:	28 days
Frequency of Treatment:	6 hours/day, 5 days/week
Exposure Levels:	0, 3, 30, 100, 300 ppm
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study.

Rats were exposed nose-only to cis-2-pentenenitrile vapor for 6 hours/day over approximately a 4-week period for a total of 20 exposures. Each exposure group was subdivided into 3 replicates of 5 rats. For each group, 1 replicate was designated for evaluation of subchronic toxicity, and the other 2 replicates were designated for neurobehavioral evaluation and neuropathology. One air-exposed control group was subjected to the same treatment and evaluation as the test groups.

During the exposures, rats were individually restrained in perforated, stainless steel or polycarbonate cylinders with conical nose pieces. The restrainers were inserted into the face plate of a 150-L stainless steel exposure chamber so that only the nose of each rat protruded into the chamber. Chamber temperature, relative humidity, and airflow were measured with an automated environmental monitoring system. Chamber oxygen concentrations were targeted to at least 19% and were measured with an oxygen monitor.

Vapors of cis-2-pentenenitrile were dynamically generated by infusing the test substance into a heated 3-neck mixing flask at a particular rate controlled by an infusion pump. Nitrogen, introduced into the heated 3-neck mixing flask, directed the resulting gas into the exposure chamber. Dilution air was delivered to the top of the chamber. The test substance vapor was dispersed using a stainless steel baffle. Atmospheric concentrations were monitored at approximately 45-minute intervals using gas chromatographic analysis.

Rats were weighed and clinical signs of toxicity were recorded. Food consumption was determined for the replicates designated for subchronic toxicity.

replicates designated for subchronic toxicity.

Urine samples were collected overnight from all rats/sex/level assigned to the subchronic toxicity group following the 20th exposure for clinical pathological evaluation. Each sample was analyzed or examined for 13 urine parameters.

Blood samples were collected from the same 5 rats/sex/level on the day following the 20th exposure, and 16 hematological parameters and 18 clinical chemistry parameters were measured or calculated. The males were not fasted prior to the evaluation, however the females were fasted overnight after being allowed access to food for approximately 2 hours following removal from the exposure chambers.

The neurobehavioral groups were given functional observational battery (FOB) assessments (encompassing 34 endpoints) and motor activity (MA) evaluations (encompassing 2 dependent variables) prior to the initiation of exposures, and on test days 11, 18, and 32.

At the end of the exposure period all rats assigned to the subchronic toxicity groups (5/sex/level) were sacrificed and examined for gross and histopathological changes. The lungs, liver, kidneys, brain, adrenal glands, and testes were weighed at necropsy. Each rat was given a gross examination and 30 tissues were examined microscopically.

Sacrifices of the neurotoxicity satellite groups were held serially after 1- and 4-weeks recovery (5/sex/group during each sacrifice). All rats had gross pathological and neuropathological examinations performed. Neuropathological assessment included gross examination of the neuromuscular system, and histopathological examination was performed on 15 tissues.

Body weights and body weight gains were analyzed by a one-way analysis of variance. When the corresponding F-test for difference among test group means was significant, pairwise comparisons between test and control groups were made with the Dunnett's test. Incidence of clinical observation was evaluated by the Fisher's Exact test with a Bonferroni correction and the Cochran-Armitage test for trend.

For clinical pathology data, a one-way analysis of variance (ANOVA) and Bartlett's test were calculated for the sampling time. When the value of F-test statistic from ANOVA was significant, Dunnett's test was used to compare means from the control groups and each of the groups exposed to the test substance. When the results of Bartlett's test were significant ($p \leq 0.005$), the Kruskal-Wallis test was employed and the Mann-Whitney U test was used to compare means from the control groups and each of the groups exposed to the test substance. Significance was judged at the 5% probability level.

Descriptive FOB parameters were evaluated first by Cochran-Armitage test for trend, then by Fisher's Exact test (with a Bonferroni correction) to determine significant experimental group differences with respect to the control group.

Body weights and continuous data from the FOB (fore- and hindlimb grip strength, landing foot splay) were analyzed as parametric data. Bartlett's test of homogeneity of variances was used to estimate the probability that the dose groups had different variances. If Bartlett's test results were not significant, the data were then analyzed via univariate analysis of variance (ANOVA), with Dunnett's test used to identify which dose groups, if any, were significantly different from the control group. If Bartlett's test was significant, data were analyzed via a Kruskal-Wallis test, with the Wilcoxon test used to identify which dose groups, if any, were significantly different from the control group.

Motor activity data were analyzed via univariate analysis of variance with DOSE as a between subjects factor and BLOCK as a repeated measure. In the event of significant effect of DOSE, totals for the control group and groups given the test substance were compared using Dunnett's test. In the event of a significant interaction of DOSE and BLOCK, Dunnett's test was used to identify which dose groups within each block, if any, were significantly different from the control group.

Analysis of grip strength data was conducted on the mean of the absolute scores collected on each of 3 trials conducted at each test interval (baseline and test days 11, 18, and 23), as well as the mean of the normalized scores collected on the same 3 trials at each interval (calculated as a percent of the baseline grip strength). Similarly, analysis of landing foot

baseline grip strength). Similarly, analysis of landing foot splay data was also conducted on both absolute and normalized scores as described previously for the grip strength data.

All significance levels for neurotoxicity parameters were judged at alpha = 0.05, with the exception of Bartlett's test which was judged at alpha = 0.005.

The incidence of gross observations were analyzed by the Fisher Exact test (alpha = 0.05) and the Cochran-Armitage test for trend (alpha = 0.05). The incidences of microscopic findings were analyzed by the Cochran-Armitage test for trend. When a trend was identified, the test was re-run excluding the highest-dose group. This procedure was repeated until either no trend was identified or only the lowest dose group and the control group remained. These 2 incidences were compared using a pair-wise comparison statistic (Fisher Exact test, alpha = 0.05). Final body weights, organ weights, and relative organ weights were statistically evaluated by a one-way analysis of variance (ANOVA). When the test for differences among test group means (value of the F test statistic) was significant (alpha = 0.05), pairwise comparisons between test and control group were made with Dunnett's test (alpha + 0.05). The Bartlett's test for homogeneity of variances (alpha = 0.05) was performed on all weight data in order to justify the use of these parametric parameters.

GLP: Yes

Test Substance: cis-2-Pentenenitrile, purity 73%

Results: The actual mean concentrations of cis-2-pentenenitrile were 0, 3.2, 31, 102, and 292 ppm corresponding to target concentrations of 0, 1, 30, 100, and 300 ppm, respectively.

During exposures, the total airflow for the chambers was targeted at approximately 33 L/min. Chamber temperatures were similar between the 5 chambers, and the mean temperatures ranged from 21-26°C. The relative humidity values were also similar between the chambers and the mean values ranged from 31-47%.

Compound-related mortality did not occur over the course of the exposure period or during the recovery period. The incidences and type of clinical observations were similar to control for males and females exposed to 3, 30, 100, or 300 ppm. A compound-related decrease in body weight and body weight gain occurred in males at exposure

body weight gain occurred in males at exposure concentrations of 30, 100, and 300 ppm. The lower body weight may be due in part to lower food consumption and lower food efficiency that were observed in males at concentrations of 30 ppm and above, and in females at 300 ppm.

Compound-related hematological alterations were not observed at any exposure concentration in either males or females. Serum sorbitol dehydrogenase activity was decreased in 100 and 300 ppm males and females, and in 30 ppm females. In addition, serum aspartate aminotransferase activity was significantly decreased in the 100 and 300 ppm females. The mechanism(s) related to the decreases in serum enzyme activity have not been determined, however, the decreased activities were considered to be compound-related and potentially adverse. Females exposed to 300 ppm also had increased urine volume and decreased urine osmolality, which were consistent with diuresis. Diuresis was not apparent in males.

There were no compound-related changes in FOB or MA parameters at any exposure concentration in either males or females. There were no compound-related gross or microscopic morphological changes in nervous tissue at any exposure concentration in either males or females.

Differences in absolute and relative organ weights in males were considered to be secondary to decreased body weight. In females, a compound-related increase in absolute and relative liver weights occurred at 300 ppm, and an increase in relative liver weights occurred at 100 ppm, however, microscopic morphological changes were not evident. Compound-related microscopic effects were observed in the nose of both male and female rats exposed to 30 ppm and above. These changes consisted of primary olfactory epithelial degeneration with secondary necrotic exudate, regeneration/metaplasia, and vacuolation of the olfactory nerve bundles.

The no-observable-adverse-effect level (NOAEL) was less than 3 ppm cis-2-pentenenitrile for male rats based on the lower body weights at 3 ppm and above. For females, the NOAEL was 3 ppm based on microscopic nasal lesions observed in female rats at 30 ppm and above, and on the changes in sorbitol dehydrogenase activity at 30 ppm and above. The NOAEL for neurotoxicity was 300 ppm in both

	above. The NOAEL for neurotoxicity was 300 ppm in both males and females.
Reference:	DuPont Co. (1993). Unpublished Data, Haskell Laboratory Report No. 170-93, "Four-Week Inhalation Neurotoxicity Study in Rats" (March 31).
Reliability:	High because a scientifically defensible or guideline method was used.

Additional References for Repeated Dose Toxicity:

Data from these additional sources were not summarized because the study design was not adequate.

DuPont Co. (2001). Unpublished Data, Haskell Laboratory, "cis-2-Pentenenitrile" (cited in 8e letter to EPA dated January 8).

DuPont Co. (1995). Unpublished Data, Haskell Laboratory Report No. 655-95, "Range-Finding Neurotoxicity Study in Rats" (November 9) (also cited in TSCA fiche OTS0557945).

Gagnaire, F. and B. Marignac (1999). Pharmacol. Toxicol., 84(6):247-254.

5.3 Developmental Toxicity

Species/Strain:	Rats/Sprague-Dawley
Sex/Number:	*In vitro*: Not specified *In vivo*: Female/3-7
Route of Administration:	*In vitro* *In vivo*: Oral
Exposure Period:	*In vitro*: 46 hours *In vivo*: 1 day
Frequency of Treatment:	Once
Exposure Levels:	*In vitro*: 0, 1.75, 2.5, 5, 7.5, 10 mM, and 1.75 + microsomes + NADPH *In vivo*: 125 mg/kg
Method:	No specific test guideline was reported. *In vitro experiment:* Nulliparous female Sprague-Dawley rats were caged with adult males for a 2-hour period. Successful mating was ascertained by the presence of sperm in the vaginal smear, and the following 24 hours was termed Day 0 of gestation (GD). Conceptuses were explanted from uteri of 10-day pregnant dams and were dissected free of decidua and Reichert's membrane leaving the visceral yolk sac, amnion, and ectoplacental cone intact. Embryos selected for culture were at neural plate stage and ventrally

selected for culture were at neural plate stage and ventrally convex. Two conceptuses were placed in a culture bottle containing inactivated pure male rat serum. The cultures were grown in the absence of antibiotics.

The test substance was dissolved in dimethyl sulfoxide (DMSO) and was added to the culture medium with or without a P-450-dependent hepatic bioactivating system. A concurrent vehicle control was used. Explants were cultured for 46 hours with a constant rotation at 37°C. Culture bottles were initially gassed with a mixture of O_2:CO_2:N_2 (5:5:90) and were regassed with a mixture of O_2:CO_2: N_2 (20:5:75) after 20 hours, O_2:CO_2:N_2 (40:5:55) after 28 hours, and O_2:CO_2 (95:5) after 44 hours of culture. Conceptuses were removed from the culture bottles after 46 hours. Only viable embryos (embryos with a beating heart) were examined for growth and morphological development. The yolk sac was assessed for its vascularization and circulation, and its diameter was recorded. The crown-rump length and head length were measured and the number of somite pairs was noted. Crown-rump length was not recorded in embryos with defective flexion. Morphological features including embryonic flexion, heart, neural tube, brain development, otic, optic, and olfactory systems, branchial bars, maxillary and mandibular processes, and limb buds were examined.

In vivo experiment: Pregnant Sprague-Dawley rats were given a single oral administration of 125 mg/kg cis-2-pentenenitrile, dissolved in olive oil, on GD10. The pregnant dams were euthanized on GD12 and the numbers of implantation sites and of embryos with a beating heart were recorded.

GLP: Unknown

Test Substance: cis-2-Pentenenitrile, purity > 98%

Results: *In vitro experiment:* The development of embryos exposed to 1.75 and 2.5 mM cis-2-pentenenitrile was similar to that of controls. Embryos exposed to 5.0 mM and above showed significant decreases in all 4 measurements of conceptus growth (yolk sac diameter, crown-rump length, head length, and number of somites), and developmental, as well as morphological alterations. The principal sites affected were the prosencephalon, the mesencephalon, and the maxillary processes, and, to a lesser extent, the auditory system. At 10 mM, 28% of the embryos were dead, and all the surviving embryos were malformed.

	Inclusion of microsomes and NADPH markedly enhanced the embryotoxic effects of 1.75 mM cis-2-pentenenitrile. The incidence of embryos with morphological defects rose from 0 to 67%. Multiple anomalies were found in about 1/3 of the embryos. Growth reduction also appeared. The yolk sac diameter, crown-rump length, head length, and number of somites of embryos exposed to 1.75 mM cis-2-pentenentrile with microsomes were significantly decreased compared to control or to 1.75 mM cis-2-pentenenitrile without microsomes (9-23% lower). In addition to the morphological defects already observed in embryos exposed to 5-10 mM cis-2-pentenenitrile alone, 1.75 mM cis-2-pentenenitrile plus the biotransformation system elicited changes in the somites 3-8 region in 56% of the embryos. *In vivo experiment:* Clinical signs of toxicity were observed in treated dams (e.g., piloerection, prostration, and/or tremors). cis-2-pentenenitrile caused maternal weight loss between GD10 and GD12. Embryo viability was not affected 48 hours after maternal dosing with cis-2-pentenenitrile on GD10. Up to 94% of the embryos (4 litters examined) exhibited allantois, trunk, and caudal extremity misdirected.
Reference:	Saillenfait, A. M. and J. P. Sabate (2000). Toxicol. Appl. Pharm., 163(2):149-163.
Reliability:	Low because an inappropriate method or study design was used.

Additional References for Developmental Toxicity: None Found.

5.4 Reproductive Toxicity: No Data.

5.5 Genetic Toxicity

Type:	***In vitro* Bacterial Reverse Mutation Test**
Tester Strain:	*Salmonella typhimurium* strains TA97, TA98, TA100, TA1535, and TA1537
Exogenous Metabolic Activation:	With and without 10% and 30% Aroclor®-induced rat and hamster liver S-9
Exposure Concentrations:	Initial Trial: 0, 33, 100, 333, 1000, 2000, and 3333 µg/plate Subsequent Trials: 0, 100, 333 or 334, 667, 1000, 2000, 3333 or 3334, 5000, and 6667 µg/plate Comment: Not all exposure concentrations were tested with all tester strains under all test conditions.

Method: No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study.

The preincubation method originally described by Haworth et al., 1983, was used with some modifications. The test substance, overnight culture of *Salmonella*, and S-9 mix or buffer were incubated at 37°C, without shaking for 20 minutes. Test substances known or suspected to be volatile were incubated in capped tubes. The top agar was added and the contents of the tubes were mixed and poured onto the surface of petri dishes containing medium. Histidine-independent (his+) colonies arising on these plates were counted following 2 days incubation at 37°C. Plates were machine counted (New Brunswick, Artek). At the discretion of the investigator, plates with low numbers of colonies, containing precipitated test substance, or having excessively-reduced contrast because of chemical color, were counted by hand.

The initial test of a test substance was without activation and with 10% S-9. If a positive result was obtained, the positive trial(s) was repeated. If the trials were negative, the test substance was retested without S-9 and with 30% S-9. If all trials were negative, no further testing was performed.

A test substance was designated nonmutagenic only after it had been tested in strains TA97, TA98, TA100, TA1535, and TA1537, without exogenous activation, and with 10% and 30% rat and hamster S-9.

2-Pentenenitrile was run initially in a toxicity assay using TA100 or the system developed by Waleh et al., 1982. Toxic concentrations were defined as those that produced a decrease in the number of his+ colonies, or a clearing in the density of the background lawn, or both.

The test substance was initially tested in the preincubation test at half-log dose intervals up to a dose that elicited toxicity, or to a dose immediately below one that was toxic in the preliminary toxicity procedure. Subsequent trials occasionally used narrower dose increments, and may not have included doses in the toxic range. At least 5 doses of the test substance were tested in triplicate, and repeat experiments were performed at least 1 week following the initial trial.

	Concurrent solvent (dimethyl sulfoxide) and positive controls were run with each trial. The positive controls in the absence of exogenous metabolic activation were sodium azide (TA1535 and TA100), 9-aminoacridine (TA97 and TA1537), and 4-nitro-o-phenylenediamine (TA98). The positive control for exogenous metabolic activation with all strains was 2-aminoanthracene. The test substance was considered mutagenic or weakly mutagenic if it produced a reproducible, dose-related response over the solvent control, under a single metabolic activation condition, in replicate trials. The test substance was considered equivocal if the results of individual trials were not reproducible, if increases in his+ revertants did not meet the criteria for a weakly positive response, or if only single doses produced increases in his+ revertants in repeat trials. The test substance was judged nonmutagenic if it did not meet the criteria for a mutagenic or questionable response.
GLP:	Unknown
Test Substance:	2-Pentenenitrile, purity 70%
Results:	Negative
Remarks:	2-Pentenenitrile was not mutagenic, with or without exogenous activation in *Salmonella typhimurium* strains TA97, TA98, TA100, TA1535, and TA1537
Reference:	Zeiger, E. et al. (1992). Environ. Mol. Mutagen., 19(Suppl. 21):2-141. Haworth, S. et al. (1983). Environ. Mutagen., 6(Suppl. 1):3-142. Waleh, N. S. et al. (1982). Mutat. Res., 97:247-256
Reliability:	High because a scientifically defensible or guideline method was used.

Additional References for *In vitro* Bacterial Reverse Mutation Studies:

Data from these additional sources support the study results summarized above. These studies were not chosen for detailed summarization because the data were not substantially additive to the database.

DuPont Co. (1978). Unpublished Data, Haskell Laboratory Report No. 752-78, "Mutagenic Activity in the *Salmonella*/Microsome Assay" (January 16) (also cited in TSCA fiche OTS0529919).

DuPont Co. (1990). Unpublished Data, Haskell Laboratory Report No. 621-90, "Mutagenicity Testing of cis-2-Pentenenitrile in the *Salmonella typhimurium* Plate Incorporation Assay" (January 25).

DuPont Co. (1990). Unpublished Data, Haskell Laboratory Report No. 425-90, "Mutagenicity Testing of 2-Pentenenitrile in the *Salmonella typhimurium* Plate Incorporation Assay" (September 13) (also cited in TSCA fiche OTS0529919).

Type:	***In vitro* Mouse Lymphoma Mutation Assay**
Cell Type:	Mouse lymphoma cells (L5178Y; TK locus)
Exogenous Metabolic Activation:	With and without Aroclor®-induced rat liver S-9
Exposure Concentrations:	Nonactivated cultures: 0.1 to 1.0 µg/mL Activated cultures: 0.0040 to 0.04 µg/mL
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study. The initial toxicity test conducted on the test substance indicated threshold levels of complete toxicity at 1.0 µg/mL for the nonactivated cultures, and at 0.5 µg/mL for the S-9 activated cultures. The test substance was tested in the mutagenesis assay over a range of concentrations from 0.10 to 1.0 µg/mL for the nonactivated cultures, and from 0.004 to 0.040 µg/mL for the S-9 activated cultures. Duplicate cultures were treated. After a 2-day expression period, 12 nonactivated cultures and 5 S-9 activated cultures were selected for cloning based on their degree of toxicity. The nonactivated cultures were cloned at test substance concentrations of 0.87, 0.74, 0.61, 0.49, 0.36, and 0.23 µg/mL. The S-9 activated cultures were cloned at test substance concentrations of 0.014, 0.0091, and 0.0040 µg/mL.
GLP:	Yes
Test Substance:	cis-2-Pentenenitrile, purity not specified
Results:	Positive
Remarks:	Both the nonactivated and S-9 activated cultures produced significant increases in mutant frequency over that of the solvent control cultures. For cultures treated in the absence of S-9 metabolic activation, 4 of the cultures exhibited an increase in mutant frequency, which ranged from 3.3 to 6.3 times greater than the average mutant frequency of the solvent control cultures. The total growth of these cultures ranged from 9-29%, and a

The total growth of these cultures ranged from 9-29%, and a dose-dependent response was evident. The remaining cultures did not exhibit significant increases in mutant frequency. The total growth of these cultures ranged from 44-98%.

For cultures treated in the presence of exogenous S-9 metabolic activation, 3 of the cultures exhibited significant increases in mutant frequency, which ranged from 2.0 to 4.2 times greater than the average mutant frequency of the corresponding solvent control cultures. The total growth of these cultures ranged from 5-25%. Neither of the remaining cultures exhibited a significant increase in mutant frequency. The total growth of these cultures were at 74% and 61%.

Reference: National Cancer Institute (1983). Microbiological Associates Study No. ML-NCI #70, Contract No. N01-CP-15739.

Reliability: High because a scientifically defensible or guideline method was used.

Additional References for *In vitro* Studies: None Found.

Type: ***In vitro* Clastogenicity Studies:** No Data.

Type: ***In vivo* Studies:** No Data.

Appendix C

ROBUST SUMMARY FOR 3-PENTENENITRILE

Existing published and unpublished data were collected and scientifically evaluated to determine the best possible study or studies to be summarized for each required endpoint. In the spirit of this voluntary program, other data of equal or lesser quality are not summarized, but are listed as related references at the end of each appropriate section, with a statement to reflect the reason why these studies were not summarized.

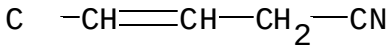
1.0 Substance Information

CAS Number: 4635-87-4 (3-pentenenitrile)
16545-78-1 (cis-3-pentenenitrile)
16529-66-1 (trans-3-pentenenitrile)

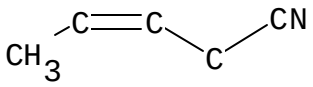
Chemical Name: 3-Pentenenitrile

Structural Formula:

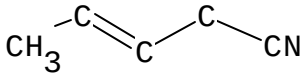
3-Pentenenitrile



cis-3-Pentenenitrile



trans-3-Pentenenitrile



Other Names: 3-Pentenenitrile

3-PN
3PN
1-Cyano-2-butene
3-Pentenonitrile
Crotyl cyanide

trans-3-Pentenenitrile

3-Pentenenitrile, (3E)-
(E)-3-Pentenenitrile
(E)-2-Butenyl cyanide
trans-1-Cyanobut-2-ene
trans-2-Butenyl cyanide
trans-3-Pentenenitrile
trans-3-Pentenonitrile

cis-3-Pentenenitrile

3-Pentenenitrile, (3Z)-
3-Pentenenitrile, (Z)-

Exposure Limits: 1 ppm; 8- and 12-hour TWA; skin notation: DuPont Acceptable Exposure Limit (AEL) (3-pentenenitrile)

2.0 Physical/Chemical Properties

2.1 Melting Point: No Data.

2.2 Boiling Point

Value:	144-147ºC
Decomposition:	Decomposes with heat
Pressure:	760 mm Hg
Method:	No Data
GLP:	Unknown
Reference:	DuPont Co. (1998). Material Safety Data Sheet DU005951 (September 18).
Reliability:	Not assignable because limited study information was available.

Additional Reference for Boiling Point:

DuPont Co. (n.d.) Data Sheet, "3-Pentenenitrile."

2.3 Density

Value:	0.83
Temperature:	20ºC
Method:	No Data
GLP:	Unknown
Results:	No additional data.
Reference:	DuPont Co. (1998). Material Safety Data Sheet DU005951 (September 18).
Reliability:	Not assignable because limited study information was available.

Additional References for Density: None Found.

2.4 Vapor Pressure

Value:	4.05 mm Hg
Temperature:	25°C
Decomposition:	No Data
Method:	Estimated using the means of Antoine & Grain methods.
GLP:	Not Applicable
Reference:	SRC MPBPWIN v1.40 in EPIWIN v3.05.

Syracuse Research Corporation (MPBPWIN) program estimates the boiling point (at 760 mm Hg), melting point, and vapor pressure of organic compounds. The vapor pressure is estimated using the mean of the Antoine and Grain methods. A description of the methodology is detailed in:

Antoine Method: Lyman, W. J. et al. (1990). Handbook of Chemical Property Estimation Methods, Chapter 14, American Chemical Society, Washington, DC.

Modified Grain Method: Lyman, W. J. (1985). In: Environmental Exposure From Chemicals, Volume I, Chapter 2, Neely, W. B. and G. E. Blau (eds.), CRC Press, Inc., Boca Raton, FL.

Reliability: Estimated value based on accepted model.

Additional Reference for Vapor Pressure:

DuPont Co. (1998). Material Safety Data Sheet DU005951 (September 18).

2.5 Partition Coefficient (log Kow)

Value:	1.11
Temperature:	Not Applicable
Method:	Modeled. The KOWWIN computer program, version 1.66 from Syracuse Research Corporation, calculates the Log octanol/water partition coefficient (log Kow) of organic chemicals using an atom/fragment contribution method.
GLP:	Not Applicable
Reference:	The methodology is described in the following journal article: Meylan, W. M. and P. H. Howard (1995). J. Pharm. Sci., 84:83-92.
Reliability:	Estimated value based on accepted model

Additional References for Partition Coefficient (log Kow): None Found.

2.6 Water Solubility:

Value:	7924 mg/L
Temperature:	22.5°C
pH/pKa:	No Data
Method:	Water solubility of the test substance was estimated by determining the total organic carbon in water to which an amount of test substance in excess of the water solubility had

amount of test substance in excess of the water solubility had been added. Samples were tested for their solubility in water after 48 and 96 hours of continuous mixing. Approximately 200 mg of the test substance, prepared in quadruplicate replicates, was added to 20 mL of deionized water in a glass test vessel with a Teflon®-coated screw cap. Two of the replicates were mixed end-over-end for 48 hours and then analyzed. The other 2 replicates were mixed end-over-end for 96 hours before analysis. Prior to analysis, the test vessels were allowed to stand for 1 hour. The upper 5 mL layer of solution was removed by pipette and discarded to eliminate test substance at the top of the test vessel. Samples were analyzed for total carbon content via an analyzer with an autosampler attachment. Water solubility was determined by assuming that the test material contained 100% test substances.

GLP: No

Reference: DuPont Co. (2002). Unpublished Data, Report No. EMSER 006-02, "Estimated Water Solubility of 3-Pentenenitrile" (January 24).

Reliability: Medium because a suboptimal study design was used.

Value: 7930 mg/L
Temperature: 25°C
pH/pKa: No Data
Method: Modeled
GLP: Not Applicable
Reference: WsKow v1.40 in EPIWIN v3.05 (SRC Database).

WsKow estimates the water solubility (WSol) of an organic compound using the compound's log octanol-water partition coefficient (log Kow). The following journal article describes the estimation methodology:

Meylan, W. M. et al. (1996). Environ. Toxicol. Chem., 15:100-106.

Reliability: Estimated value based on accepted model.

Additional References for Water Solubility: None Found.

2.7 Flash Point

Value: 40ºC
Method: Closed cup
GLP: Unknown
Reference: DuPont Co. (1998). Material Safety Data Sheet DU005951

(September 18).
Reliability: Not assignable because limited study information was available.

Additional Reference for Flash Point:

DuPont Co. (n.d.). Data Sheet, "3-Pentenenitrile."

2.8 Flammability

Results: Vapor forms explosive mixture with air.
Method: No Data
GLP: Unknown
Reference: DuPont Co. (1998). Material Safety Data Sheet DU005951 (September 18).
Reliability: Not assignable because limited study information was available.

Additional References for Flammability: None Found.

3.0 Environmental Fate

3.1 Photodegradation

Concentration: Not Applicable
Temperature: Not Applicable
Direct Photolysis: Not Applicable
Indirect Photolysis: Not Applicable
Breakdown Products: Not Applicable
Method: The AOP Program, Version 1.90 from Syracuse Research Corporation, estimates the Atmospheric Oxidation Potential. The AOP program estimates the rate constant for the atmospheric, gas-phase reaction between photochemically produced hydroxyl radicals and organic chemicals. The methodology used by the Atmospheric Oxidation Program is based upon the structure-activity relationship (SAR) methods developed by Dr. Roger Atkinson and co-workers (Atkinson et al., 1987; 1995; 1996; 1984).

The rate constant for the reaction of 3-pentenenitrile vapor with photochemically generated hydroxyl radicals in the atmosphere is estimated to be 2.8×10^{-11} cm^3/molecule-sec for the cis-isomer and 3.2×10^{-11} cm^3/molecule-sec for the trans isomer at 25°C (SRC AopWin v1.90). These values correspond to respective half-lives of 0.6 days and 0.5 days, assuming a 24 hour day and an ambient hydroxyl radical concentration of 0.5×10^6 molecules/cm^3.

	concentration of $0.5x10^6$ molecules/cm^3.
GLP:	Not Applicable
Reference:	Atkinson, R. et al. (1987). Intern. J. Chem. Kinet., 19:799-828.
	Atkinson, R. et al. (1995). Atmos. Environ., 29:1685-1695.
	Atkinson, R. et al. (1996). Environ. Sci. Technol., 30:329-334.
	Atkinson, R. et al. (1984). Chem. Rev., 84:437-470.
	The following journal article describes the AOP Program:
	Meylan, W. M. and P. H. Howard (1993). Chemosphere, 26:2293-2299.
Reliability:	Estimated value based on accepted model.

Additional References for Photodegradation: None Found.

3.2 Stability in Water

Concentration:	Not Applicable
Half-life:	The Henry's Law constant for 3-pentenenitrile is estimated to be $6.29x10^{-5}$ atm-m^3/mole (SRC HENRYWIN v3.10 in EPIWIN v3.05) from its estimated vapor pressure of 4.05 mm Hg (SRC MPBPWIN v1.40 in EPIWIN v3.05, mean of Antoine & Grain methods) and water solubility of 7930 mg/L (WsKow v1.40 in EPIWIN v 3.05). The estimated volatilization half-life from a model river (1 m deep, flowing 1 m/sec, wind velocity of 5 m/sec) is approximately 9.3 hours. The estimated volatilization half-life from a model lake (1 m deep, flowing 0.05 m/sec, wind velocity of 0.5 m/sec) is approximately 7.4 days (EPIWIN v3.05).
% Hydrolyzed:	Not Applicable
Method:	Modeled. The WVOL program estimates the volatilization half-lives from a model river and lake using the methodology from Lyman et al., 1990 (adsorption to suspended solids and sediments is ignored). The user can input an experimental water solubility, vapor pressure, or Henry's Law constant or EPI will automatically estimate a Henry's Law Constant from SRC's Henry program for this calculation. WsKow estimates the water solubility (WSol) of an organic compound using the compound's log octanol-water partition coefficient (Kow).

GLP:	Not Applicable
Reference:	Lyman, W. J. et al. (1990). The Handbook of Chemical Property Estimation Methods, American Chemical Society.
	The following journal article describes the estimation methodology:
	Meylan, W. M. et al. (1996). Environ. Toxicol. Chem., 15:100-106.
Reliability:	Estimated value based on accepted model.

Additional References for Stability in Water: None Found.

3.3 Transport (Fugacity)

Media:	Air, Water, Soil, and Sediments	
Distributions:	Air:	0.5%
	Water:	45.1 %
	Soil:	54.3%
	Sediments:	0.1%
Half-life:	Air:	1.8 hours
	Water:	360 hours
	Soil:	720 hours
	Sediment:	3240 hours
Adsorption Coefficient:	Not Applicable	
Desorption:	Not Applicable	
Volatility:	Not Applicable	
Method:	Calculated according to Mackay, Level III, Syracuse Research Corporation EPIWIN version 3.05. Emissions (1000 kg/hr) to air, water, and soil compartments using standard EPA model defaults with BIOWIN half-life factors of water, 1; soil, 2; and sediments, 9.	
	Data Used: Molecular Weight: 81.12 Henry's Law Constant: 6.29×10^{-5} atm-m^3/mole (HenryWin Program) Vapor Pressure: 4.05 mm Hg (MPBPWIN v1.40) Log Kow: 1.11 (KowWin Program) Soil Koc: 5.28 (Log Kow estimate)	
GLP:	Not Applicable	
Reference:	Syracuse Research Corporation EPIWIN v3.05 contains a Level III fugacity model. The methodology and programming approach were developed by Dr. Donald MacKay and coworkers and are detailed in:	

Mackay, D. (1991). Multimedia Environmental Models: The Fugacity Approach, pp. 67-183, Lewis Publishers, CRC Press.

Mackay, D. et al. (1996). Environ. Toxicol. Chem., 15(9):1618-1626.

Mackay, D. et al. (1996). Environ. Toxicol. Chem., 15(9):1627-1637

Reliability: Estimated value based on accepted model.

Additional References for Transport (Fugacity): None Found.

3.4 Biodegradation:

Value:	21% after 28 days (Not Readily Biodegradable)
Breakdown Products:	No Data
Method:	The procedures used in the test were based on the recommendations of the following guideline: OECD Guideline 301B. The biodegradability of 3-pentenenitrile was tested using the Modified Sturm test. Biodegradability was measured as CO_2 evolution. A test substance is considered "Readily Biodegradable" if it demonstrates a "pass level" of 60% biodegradability within a 10-day window after exceeding the 10% level of biodegradability. A test substance is considered "Ultimately Biodegradable" if it demonstrates a "pass level" of 60% biodegradability, but not within a 10-day window after exceeding the 10% level of biodegradability. 3-Pentenenitrile reached a peak of 21% biodegradability at day 28, and therefore is regarded as not "Readily Biodegradable." 3-Pentenenitrile was not inhibitory to microorganisms in the inoculum.
GLP:	No
Reference:	DuPont Co. (2001). Unpublished Data, Report No. EMSE-071-01, "Biodegradability of 3-Pentenenitrile Using the Modified Sturm Test (OECD 301B)" (December 17).
Reliability:	High because a scientifically defensible or guideline method was used.

Additional References for Biodegradation: None Found.

3.5 Bioconcentration

Value:	BCF = 1.44. This BCF value suggests that bioconcentration potential in aquatic organisms is low.
Method:	The bioconcentration factor is calculated by Syracuse Research Corporation's BCFWIN Computer Program, Version 2.14, which utilizes a linear regression based on the Log Kow for the compound.
GLP:	Not Applicable
Reference:	The estimation methodology used by BCFWIN is described in the following document prepared for the U.S. Environmental Protection Agency (OPPT): "Improved Method for Estimating Bioconcentration Factor (BCF) from Octanol-Water Partition Coefficient," SRC TR-97-006 (2^{nd} Update), July 22, 1997; prepared for Robert S. Boethling, EPA-OPPT, Washington, DC, Contract No. 68-D5-0012; prepared by William M. Meylan, Philip H. Howard, Dallas Aronson, Heather Printup, and Sybil Gouchie, Syracuse Research Corp., Environmental Science Center, 6225 Running Ridge Road, North Syracuse, NY 13212.
Reliability:	Estimated value based on accepted model.

Additional References for Bioconcentration: None Found.

4.0 Ecotoxicity

4.1 Acute Toxicity to Fish

Type:	**96-hour LC_{50}**
Species:	*Pimephales promelas* (fathead minnow)
Value:	>100 mg/L
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used that was consistent with OECD Guideline 203, with the following exceptions: 10x dose spacing, 4 test concentrations, and nominal test concentrations were reported. The acute toxicity to fathead minnows was determined in an unaerated, 96-hour, static test. The nominal concentrations of 3-pentenenitrile used were 0, 0.10, 1, 10, and 100 mg/L at a mean temperature of 21.6°C. One test chamber was used per test concentration with 10 test organisms in each chamber. Analysis of the test and control solution samples for

	Analysis of the test and control solution samples for dissolved oxygen and pH were made at test initiation (0 hours) and test completion (96 hours).
GLP:	No
Test Substance:	3-Pentenenitrile, purity 98%
Results:	Based on visual observations, the water control and the 0.1, 1, 10, and 100 mg/L test concentrations were clear and colorless at test start. All water quality parameters were within acceptable limits during the exposure. At test initiation (0 hours), dissolved oxygen was 8.7 mg/L and pH ranged from 7.5-7.6. At test completion (96 hours) dissolved oxygen ranged from 6.0-6.8 and pH was 7.5. Exposure of fathead minnows to nominal concentrations of 0, 0.1, 1, 10, and 100 mg/L 3-pentenenitrile resulted in 0% mortality at any concentration at the end of 96 hours. The test substance exhibited low concern for aquatic hazard in the unaerated, 96-hour, static, acute test using the fathead minnow.
Reference:	DuPont Co. (2001). Unpublished Data, Haskell Laboratory Report No. DuPont-8175, "Static, Acute, 96-Hour Screening Test to *Pimephales promelas*" (November 19).
Reliability:	Medium because a suboptimal study design was used (nominal test concentrations).

Additional References for Acute Toxicity to Fish: None Found.

4.2 Acute Toxicity to Invertebrates

Type:	**48-hour EC_{50}**
Species:	*Daphnia magna*
Value:	>100 mg/L
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used that was consistent with OECD Guideline 202, with the following exceptions: 10x dose spacing, 4 test concentrations, nominal test concentrations were reported, and 1 replicate per test concentration was performed. The acute toxicity of 3-pentenenitrile to the water flea, *Daphnia magna* (less than 24-hours old) was determined in an unaerated, 48-hour, static test. The study was conducted at concentrations of 0, 0.1, 1.0, 10, and 100 mg/L at a mean temperature of 20.2°C (range of 19.8-20.5°C). One test chamber was used per test concentration with 10 test organisms in each chamber.

GLP:	No
Test Substance:	3-Pentenenitrile, purity 98%
Results:	Based on visual observations, the water control and the 0.1, 1, 10, and 100 mg/L test concentrations were clear and colorless at test start. All water quality parameters were within acceptable limits during the exposure. Dissolved oxygen was 8.7-8.8 and 8.5-8.6 mg/L at test initiation (0 hours) and test completion (48 hours), respectively. pH was 7.4-7.8 and 7.8-7.9 at test initiation (0 hours) and test completion (48 hours), respectively. Immobility was 0% in all test concentrations at the end of 48 hours. No immobility or sublethal effects were observed in the water control test organisms. The highest nominal concentration causing no immobility at test end was 100 mg/L. The test substance exhibited low concern for aquatic hazard in an unaerated, 48-hour, static, acute test using *Daphnia magna* (less than 24 hours old).
Reference:	DuPont Co. (2001). Unpublished Data, Haskell Laboratory Report No. DuPont-8176, "Static, Acute, 48-Hour Screening Test to *Daphnia magna*" (October 26).
Reliability:	Medium because a suboptimal study design was used (nominal test concentrations).

Additional References for Acute Toxicity to Invertebrates: None Found.

4.3 Acute Toxicity to Aquatic Plants: No Data.

5.0 Mammalian Toxicity

5.1 Acute Toxicity

Type:	**Oral ALD**
Species/Strain:	Male rats/ChR-CD
Value:	300 mg/kg
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study. 3-Pentenenitrile, as a solution in peanut oil, was administered in single doses via intragastric intubation to young adult male rats at 90, 130, 200, 300, 450, 670, 2250, or 5000 mg/kg. Survivors were sacrificed 14 days later.
GLP:	No
Test Substance:	3-Pentenenitrile, purity approximately 100%
Results:	Mortality occurred at ≥ 300 mg/kg within 1 day. Toxic signs observed at lethal doses included unresponsiveness (2250 and 5000 mg/kg), rapid respiration (2250 and 5000 mg/kg),

and 5000 mg/kg), rapid respiration (2250 and 5000 mg/kg), initial weight losses (300, 450, and 670 mg/kg), hyperemic extremities (300, 450, and 670 mg/kg), and polyuria (300, 450, and 670 mg/kg). The non-lethal dose levels of 200, 130, and 90 mg/kg caused initial weight losses. At 200 mg/kg the rat salivated, had hyperemic extremities, polyuria, and was barely responsive on the day of treatment. On the day following treatment, the rat still showed hyperemia and had a rapid respiratory rate; recovery from these signs was evident on the 3rd day after dosing. At 130 mg/kg toxic signs occurred only on the day of treatment and included salivation and polyuria.

Reference: DuPont Co. (1967). Unpublished Data, Haskell Laboratory Report No. 197-67, "Acute Oral Test" (November 8).

Reliability: High because a scientifically defensible or guideline method was used.

Additional References for Acute Oral Toxicity:

Data from this additional source were not summarized because the test substance was a mixture or otherwise inappropriate.

DuPont Co. (1982). Unpublished Data, Haskell Laboratory Report No. 656-82, "Oral LD_{50} Test in Rats" (October 19) (also cited in TSCA fiche OTS0555851).

Data from this additional source were not summarized because the study design was not adequate.

Tanii, H. et al. (1989). Neurotoxicology, 10:157-166.

Type: **Inhalation LC_{50}**
Species/Strain: Male rats/ChR-CD
Exposure Time: 4 hours
Value: 420 ppm (95% confidence interval, 362-478 ppm)
Method: No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study.

Male rats (6/exposure level), weighing 250-289 g, were exposed to nominal concentrations of 338, 359, 447, 538, or 692 ppm 3-pentenenitrile in a 16 L bell jar for 4 hours. The test substance was metered at a uniform rate into a heated stainless steel T-tube by a syringe drive and vaporized under prepurified nitrogen. The test substance vapors were mixed with oxygen and carried into the bell jar. Houseline air was used as diluent to give the desired atmospheric concentration. Gas samples were taken periodically from

	concentration. Gas samples were taken periodically from the chamber exit and analyzed by gas chromatography. Gross and histopathologic examinations were performed on 2 rats each at 1, 2, 7, and 14 days post-exposure. Tissues examined included lungs, liver, spleen, kidney, testes, and thymus. The other survivors were sacrificed 14 days post-exposure.
GLP:	No
Test Substance:	3-Pentenenitrile, purity approximately 100%
Results:	Mortality was 0/6, 2/6, 1/6, 3/6, and 5/6 at 338, 359, 447, 538, and 692 ppm, respectively. Death occurred from 2.5 hours to overnight. Clinical signs observed at lethal concentrations during exposure included irregular respiration, hyperemia, red discharge around the eyes, tremors, salivation, and pale ears. Clinical signs observed at non-lethal concentrations during exposure included irregular respiration, incoordination, red discharge from the nose, and hindleg tremors. Clinical signs observed post-exposure at lethal concentrations included hypersensitivity and initial weight loss followed by normal weight gain. Clinical signs observed post-exposure at non-lethal concentrations included incontinence and initial weight loss followed by normal weight gain. Gross and histopathologic examination revealed no anatomical evidence of primary injury.
Reference:	DuPont Co. (1970). Unpublished Data, Haskell Laboratory Report No. 301-70, "Acute Inhalation Toxicity" (July 15) (also cited in TSCA fiche OTS0555686).
	DuPont Co. (1968). Unpublished Study Data (January 16).
Reliability:	High because a scientifically defensible or guideline method was used.

Additional References for Acute Inhalation Toxicity: None Found.

Type: **Dermal Toxicity:** No Data.

Additional Reference for Acute Dermal Toxicity:

Data from this additional source were not summarized because the test substance was a mixture or otherwise inappropriate.

DuPont Co. (1983). Unpublished Data, Haskell Laboratory Report No. 67-83, "Acute Skin Absorption LD_{50} Test on Rabbits" (March 10) (also cited in TSCA Fiche OTS0570947).

Type:	**Dermal Irritation**
Species/Strain:	Male guinea pigs/Albino
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study. In a test for primary irritation, applications of 1 drop of undiluted 3-pentenenitrile or of a solution in 1:1 acetone-dioxane containing 13% guinea pig fat (f.a.d.) were applied to the intact shaved skin of male guinea pigs. Reactions for primary irritation were observed at 1 and 2 days.
GLP:	No
Test Substance:	3-Pentenenitrile, purity approximately 100%
Results:	At the 100% concentration, mild erythema was observed in 1 animal and no reaction was observed in 9 guinea pigs at 1 day. Reaction for primary irritation was not observed at 2 days. At 43%, 10/10 guinea pigs were negative for primary irritation after 1 and 2 days.
Reference:	DuPont Co. (1968). Unpublished Data, Haskell Laboratory Report No. 91-68, "Primary Skin Irritation and Sensitization Tests" (September 5).
Reliability:	High because a scientifically defensible or guideline method was used.

Additional References for Dermal Irritation: None Found.

Type:	**Dermal Sensitization**
Species/Strain:	Male guinea pigs/Albino
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study. In a test for sensitization potential, an exposure series was given during a 3-week interval. Five guinea pigs received 9 applications of 100% of the test substance, and 5 others received 4 intradermal injections (each 0.1 mL of 0.85% solution in dimethyl phthalate). A 2-week rest period was followed by a challenge test consisting of applications of 100% test substance and 43% solution in 1:1 acetone-dioxane containing 13% guinea pig fat (f.a.d.) to both intact and abraded skin.
GLP:	No
Test Substance:	3-Pentenenitrile, purity approximately 100%
Results:	3-Pentenenitrile (100%) produced mild erythema in 5 and no erythema in 5 guinea pigs in intact skin after 1 day. At 43%, mild erythema in 1 and no erythema in 9 guinea pigs was

	mild erythema in 1 and no erythema in 9 guinea pigs was observed in intact skin after 1 day. 3-Pentenenitrile (100%) produced mild erythema in 6 and no erythema in 5 guinea pigs in abraded skin after 1 day. At 43%, mild erythema in 6 guinea pigs and no erythema in 4 guinea pigs were observed in abraded skin after 1 day. All reactions were negative (100% and 43%) in intact and abraded skin after 2 days. The total number of guinea pigs sensitized by the test substance was 0/10.
Reference:	DuPont Co. (1968). Unpublished Data, Haskell Laboratory Report No. 91-68, "Primary Skin Irritation and Sensitization Tests" (September 5).
Reliability:	High because a scientifically defensible or guideline method was used.

Additional References for Dermal Sensitization: None Found.

Type:	**Eye Irritation**
Species/Strain:	Rabbits/Albino
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study. Undiluted 3-pentenenitrile (0.1 mL) was instilled into the right conjunctival sac of each of two rabbit eyes. Twenty seconds after contact, 1 exposed eye was washed with tap water for 1 minute. The exposed eye of the other rabbit was not washed. Observations were made with a hand slit lamp at 1 and 4 hours and at 1, 2, 3, and 7 days. A biomicroscope was used at examinations at and after 4 hours, and fluorescein stain was used after the day of treatment.
GLP:	No
Test Substance:	3-Pentenenitrile, purity approximately 100%
Results:	Temporary mild corneal injury and conjunctival irritation without significant iritic change was observed. Differences between washed and unwashed eyes were considered within normal variation, and both eyes were normal within 7 days.
Reference:	DuPont Co. (1968). Unpublished Data, Haskell Laboratory Report No. 91-68, "Eye Irritation Test" (September 5).
Reliability:	High because a scientifically defensible or guideline method was used.

Additional References for Eye Irritation: None Found.

5.2 Repeated Dose Toxicity

Type:	**2-Week Inhalation**
Species/Strain:	Rats/ChR-CD
Sex/Number:	Male/6 per exposure level
Exposure Period:	2 weeks (total of 10 exposures)
Frequency of Treatment:	4 hours
Exposure Levels:	0, 55 ppm
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study. Male rats, weighing 250-289 g, were exposed to 3-pentenenitrile in a 16 L bell jar for 4 hours/day for 2 weeks. The test substance was metered at a uniform rate into a heated stainless steel T-tube by a syringe drive and vaporized under prepurified nitrogen. The test substance vapors were mixed with oxygen and carried into the bell jar. Houseline air was used as diluent to give the desired atmospheric concentration. Gas samples were taken periodically from the chamber exit and analyzed by a gas chromatography. Six control rats were exposed to oxygen and nitrogen for the same amount of time. Three control and 3 test rats were sacrificed after the 10^{th} exposure for gross and histopathologic examination. The remaining animals were sacrificed for gross and histopathologic examination following a 14-day recovery period. Tissues examined included lungs, liver, spleen, kidney, testes, and thymus.
GLP:	No
Test Substance:	3-Pentenenitrile, purity approximately 100%
Results:	No deaths occurred during this study. Clinical signs observed during exposure included mild hyperemia and red discharge around the eyes. Normal weight gain was observed post-exposure. Gross and histopathologic examination revealed no evidence of primary injury by the test substance.
Reference:	DuPont Co. (1970). Unpublished Data, Haskell Laboratory Report No. 301-70, "Subacute Inhalation Toxicity" (July 15) (also cited in TSCA fiche OTS0555686).
Reliability:	Medium because a suboptimal study design was used.

Additional References for Repeated Dose Toxicity:

Data from these additional sources were not summarized because the study design was not adequate.

DuPont Co. (1995). Unpublished Data, Haskell Laboratory Report No. 655-95, "Range-Finding Neurotoxicity Study in Rats" (November 9) (also cited in TSCA fiche OTS0557945).

Gagnaire, F. et al. (1998). J. Appl. Toxicol., 18(1):25-31.

5.3 Developmental Toxicity: No Data.

5.4 Reproductive Toxicity: No Data.

5.5 Genetic Toxicity

Type:	***In vitro* Bacterial Reverse Mutation Test**
Tester Strain:	*Salmonella typhimurium* strains TA97, TA98, TA100, TA104, TA1535, and TA1537
Exogenous Metabolic Activation:	With and without 10 and 30% Aroclor®-induced rat and hamster liver S-9
Exposure Concentrations:	Initial Trial: 0, 33, 100, 333, 1000, 3333, 5000, and 6667 µg/plate Subsequent Trials: 0, 33, 100, 333, 667, 750, 1000, 1250, 1500, 2000, 3333, 4000, and 6667 µg/plate
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study. The preincubation method originally described by Haworth et al., 1983, was used with some modifications. The test substance, overnight culture of *Salmonella*, and S-9 mix or buffer were incubated at 37°C, without shaking for 20 minutes. Test substances known or suspected to be volatile were incubated in capped tubes. The top agar was added and the contents of the tubes were mixed and poured onto the surface of petri dishes containing medium. Histidine-independent (his+) colonies arising on these plates were counted following 2 days incubation at 37°C. Plates were machine counted (New Brunswick, Artek). At the discretion of the investigator, plates with low numbers of colonies, containing precipitated test substance, or having excessively-reduced contrast because of chemical color,

excessively-reduced contrast because of chemical color, were counted by hand.

The initial test of the test substance was without activation and with 10% S-9. If a positive result was obtained, the positive trial(s) was repeated. If the trials were negative, the test substance was retested without S-9 and with 30% S-9. If all trials were negative, no further testing was performed.

A test substance was designated nonmutagenic only after it had been tested in strains TA97, TA98, TA100, TA1535, and TA1537, without exogenous activation, and with 10% and 30% rat and hamster S-9.

3-Pentenenitrile was run initially in a toxicity assay using TA100 or the system developed by Waleh et al., 1982. Toxic concentrations were defined as those that produced a decrease in the number of his+ colonies, or a clearing in the density of the background lawn, or both.

The test substance was initially tested in the preincubation test at half-log dose intervals up to a dose that elicited toxicity, or to a dose immediately below one that was toxic in the preliminary toxicity procedure. Subsequent trials occasionally used narrower dose increments, and may not have included doses in the toxic range. At least 5 doses of the test substance was tested in triplicate, and repeat experiments were performed at least 1 week following the initial trial.

Concurrent solvent (dimethyl sulfoxide) and positive controls were run with each trial. The positive controls in the absence of exogenous metabolic activation were sodium azide (TA1535 and TA100), 9-aminoacridine (TA97 and TA1537), and 4-nitro-o-phenylenediamine (TA98). The positive control for exogenous metabolic activation with all strains was 2-aminoanthracene.

The test substance was considered mutagenic or weakly mutagenic if it produced a reproducible, dose-related response over the solvent control, under a single metabolic activation condition, in replicate trials. The test substance was considered questionable if the results of individual trials were not reproducible, if increases in his+ revertants did not meet the criteria for a weakly positive response, or if only single doses produced increases in his+ revertants in repeat trials. The test substance was judged nonmutagenic if it did

	trials. The test substance was judged nonmutagenic if it did not meet the criteria for a mutagenic or questionable response.
GLP:	Unknown
Test Substance:	3-Pentenenitrile, purity >95%
Results:	Equivocal
Remarks:	3-Pentenenitrile produced weakly mutagenic or equivocal results with and without exogenous activation in *Salmonella typhimurium* strains TA97 and TA100. 3-Pentenenitrile was non-mutagenic with or without exogenous activation in *Salmonella typhimurium* strains TA98, TA1535, and TA1537.
Reference:	Zeiger, E. et al. (1992). Environ. Mol. Mutagen., 19(Suppl. 21):2-141. Haworth, S. et al. (1983) in Environ. Mutagen., 6(Suppl. 1):3-142. Waleh, N. S. et al. (1982). Mutat. Res., 97:247-256.
Reliability:	High because a scientifically defensible or guideline method was used.

Additional Reference for *In vitro* Bacterial Reverse Mutation Studies:

Data from this additional source support the study results summarized above. This study was not chosen for detailed summarization because the data were not substantially additive to the database.

DuPont Co. (1978). Unpublished Data, Haskell Laboratory Report No. 753-78, "Mutagenic Activity in the Salmonella/Microsome Assay" (December 19).

Type: ***In vitro* Clastogenicity Studies:** No Data.

Type: ***In vivo* Studies:** No Data.

Appendix D

12 November 2002

ROBUST SUMMARY FOR 4-PENTENENITRILE

Existing published and unpublished data were collected and scientifically evaluated to determine the best possible study or studies to be summarized for each required endpoint. In the spirit of this voluntary program, other data of equal or lesser quality are not summarized, but are listed as related references at the end of each appropriate section, with a statement to reflect the reason why these studies were not summarized.

1.0 Substance Information

CAS Number: 592-51-8

Chemical Name: 4-Pentenenitrile

Structural Formula: $CH_2{=}{=}CH{-}CH_2{-}C{\equiv}N$

Other Names:
3-Butenyl cyanide
4-Cyano-1-butene
4-Pentenonitrile
Allylacetonitrile
1-Cyano-3-butene
Allylmethyl cyanide
4-Pentenoic acid, nitrile

Exposure Limits: No Data.

2.0 Physical/Chemical Properties

2.1 Melting Point: Not Applicable.

2.2 Boiling Point:

Value:	140°C
Decomposition:	No Data
Pressure:	No Data
Method:	No Data
GLP:	Unknown
Reference:	Weast, R. C. (ed.) (1979). Handbook of Chemistry and Physics, 60th ed., p. C-422, CRC Press, Inc., Boca Raton, FL (HSDB/5709).
Reliability:	Not assignable because limited study information was available.

Additional References for Boiling Point: None Found.

2.3 Density

Value:	0.8239
Temperature:	24°C
Method:	No Data
GLP:	Unknown
Results:	No additional data.
Reference:	Weast, R. C. (ed.) (1979). Handbook of Chemistry and Physics, 60th ed., p. C-422, CRC Press, Inc., Boca Raton, FL (HSDB/5709).
Reliability:	No assignable because limited study information was available.

Additional References for Density: None Found.

2.4 Vapor Pressure

Value:	6.36 mm Hg
Temperature:	25°
Decomposition:	Not Applicable
Method:	Estimated using the means of Antoine & Grain methods.
GLP:	Not Applicable
Reference:	SRC MPBPWIN v1.40 in EPIWIN v3.05. Syracuse Research Corporation (MPBPWIN) program estimates the boiling point (at 760 mm Hg), melting point, and vapor pressure of organic compounds. The vapor pressure is estimated using the mean of the Antoine and Grain methods. A description of the methodology is detailed in: *Antoine Method*: Lyman, W. J. et al. (1990). Handbook of Chemical Property Estimation Methods, Chapter 14, American Chemical Society, Washington, DC. *Modified Grain Method:* Lyman, W. J. (1985). In: Environmental Exposure From Chemicals, Volume I, Chapter 2, Neely, W. B. and G. E. Blau (eds.), CRC Press, Inc., Boca Raton, FL.
Reliability:	Estimated value based on accepted model.

Additional References for Vapor Pressure: None Found.

2.5 Partition Coefficient (log Kow)

Value:	1.19
Temperature:	No Data
Method:	Modeled. The KOWWIN computer program, version 1.66 from Syracuse Research Corporation, calculates the Log octanol/water partition coefficient (log Kow) of organic chemicals using an atom/fragment contribution method.
GLP:	Not Applicable
Reference:	The methodology is described in the following journal article: Meylan, W. M. and P. H. Howard (1995). J. Pharm. Sci., 84:83-92.
Reliability:	Estimated value based on accepted model.

Additional References for Partition Coefficient (log Kow): None Found.

2.6 Water Solubility

Value:	6794 mg/L
Temperature:	25°
pH/pKa:	No Data
Method:	Modeled
GLP:	Not Applicable
Reference:	WsKow v1.40 in EPIWIN v3.05 (SRC Database). WsKow estimates the water solubility (WSol) of an organic compound using the compound's log octanol-water partition coefficient (log Kow). The following article describes the estimation methodology: Meylan, W. M. et al. (1996). Environ. Toxicol. Chem., 15:100-106.
Reliability:	Estimated value based on accepted model.

Additional Reference for Water Solubility:

Weast, R. C. (ed.) (1979). Handbook of Chemistry and Physics, 60th ed., p. C-422, CRC Press, Inc., Boca Raton, FL (HSDB/5709).

2.7 Flash Point: No Data.

2.8 Flammability: No Data.

3.0 Environmental Fate

3.1 Photodegradation

Concentration:	Not Applicable
Temperature:	Not Applicable
Direct Photolysis:	Not Applicable
Indirect Photolysis:	Not Applicable
Breakdown Products:	Not Applicable
Method:	The AOP Program, Version 1.90 from Syracuse Research Corporation, estimates the Atmospheric Oxidation Potential. The AOP program estimates the rate constant for the atmospheric, gas-phase reaction between photochemically produced hydroxyl radicals and organic chemicals. The methodology used by the Atmospheric Oxidation Program is based upon the structure-activity relationship (SAR) methods developed by Dr. Roger Atkinson and co-workers (Atkinson et al., 1987; 1995; 1996; 1984). The rate constant for the reaction of 4-pentenenitrile vapor with photochemically generated hydroxyl radicals in the atmosphere is estimated to be 2.6×10^{-11} cm^3/molecule-sec at 25°C (SRC AopWin v1.90). This value corresponds to a half-life of 0.6 days, assuming a 24 hour day and an ambient hydroxyl radical concentration of 0.5×10^6 molecules/cm^3.
GLP:	Not Applicable
Reference:	Atkinson, R. et al. (1987). Intern. J. Chem. Kinet., 19:799-828. Atkinson, R. et al. (1995). Atmos. Environ., 29:1685-1695. Atkinson, R. et al. (1996). Environ. Sci. Technol., 30:329-334. Atkinson, R. et al. (1984). Chem. Rev., 84:437-470. The following journal article describes the AOP Program: Meylan, W. M. and P. H. Howard (1993). Chemosphere, 26:2293-2299.
Reliability:	Estimated value based on accepted model.

Additional References for Photodegradation: None Found.

3.2 Stability in Water

Concentration:	Not Applicable
Half-life:	The Henry's Law constant for 4-pentenenitrile is estimated to be 2.39×10^{-5} atm-m^3/mole (SRC HENRYWIN v3.10 in EPIWIN v3.05) from its estimated vapor pressure of 6.36 mm Hg (SRC MPBPWIN v1.40 in EPIWIN v3.05, mean of Antoine & Grain methods) and water solubility of 6794 mg/L (WsKow v1.40 in EPIWIN v 3.05). The estimated volatilization half-life from a model river (1 m deep, flowing 1 m/sec, wind velocity of 5 m/sec) is approximately 23 hours. The estimated volatilization half-life from a model lake (1 m deep, flowing 0.05 m/sec, wind velocity of 0.5 m/sec) is approximately 13.6 days (EPIWIN v3.05).
% Hydrolyzed:	Not Applicable
Method:	Modeled. The WVOL program estimates the volatilization half-lives from a model river and lake using the methodology from Lyman et al., 1990 (adsorption to suspended solids and sediments is ignored). The user can input an experimental water solubility, vapor pressure, or Henry's Law constant or EPI will automatically estimate a Henry's Law Constant from SRC's Henry program for this calculation. WsKow estimates the water solubility (WSol) of an organic compound using the compounds log octanol-water partition coefficient (Kow).
GLP:	Not Applicable
Reference:	Lyman, W. J. et al. (1990). The Handbook of Chemical Property Estimation Methods, American Chemical Society, Washington DC. The following journal article describes the estimation methodology: Meylan, W. M. et al. (1996). Environ. Toxicol. Chem., 15:100-106.
Reliability:	Estimated value based on accepted model.

Additional References for Stability in Water: None Found.

3.3 Transport (Fugacity)

Media:	Air, Water, Soil, and Sediments	
Distributions:	Air:	1.5%
	Water:	42.6 %
	Soil:	55.8%
	Sediments:	0.09%
Half-life:	Air:	8.8 hours
	Water:	360 hours
	Soil:	720 hours
	Sediment:	3240 hours
Adsorption Coefficient:	Not Applicable	
Desorption:	Not Applicable	
Volatility:	Not Applicable	
Method:	Calculated according to Mackay, Level III, Syracuse Research Corporation EPIWIN version 3.05. Emissions (1000 kg/hr) to air, water, and soil compartments using standard EPA model defaults with BIOWIN half-life factors of water, 1; soil, 2; and sediments, 9.	
	Data Used: Molecular Weight: 81.12 Henry's Law Constant: 2.39×10^{-5} atm-m^3/mole (HenryWin Program) Vapor Pressure: 6.36 mm Hg (MPBPWIN v1.40) Log Kow: 1.19 (KowWin Program) Soil Koc: 6.35 (Log Kow estimate)	
GLP:	Not Applicable	
Reference:	Syracuse Research Corporation EPIWIN v3.05 contains a Level III fugacity model. The methodology and programming approach were developed by Dr. Donald MacKay and coworkers and are detailed in:	
	Mackay, D. (1991). Multimedia Environmental Models: The Fugacity Approach, pp. 67-183, Lewis Publishers, CRC Press.	
	Mackay, D. et al. (1996). Environ. Toxicol. Chem., 15(9):1618-1626.	
	Mackay, D. et al. (1996). Environ. Toxicol. Chem., 15(9):1627-1637.	
Reliability:	Estimated value based on accepted model.	

Additional References for Transport (Fugacity): None Found.

3.4 Biodegradation

Value:	Linear Model Prediction: Biodegrades Fast Non-Linear Model Prediction: Biodegrades Fast Ultimate Biodegradation Timeframe: Weeks Primary Biodegradation Timeframe: Days-Weeks MITI Linear Model Prediction: Biodegrades Fast MITI Non-Linear Model Prediction: Biodegrades Fast
Method:	Modeled; BIOWIN v.4.0
GLP:	Not Applicable
Reference:	The Biodegradation Probability Program (BIOWIN for MS-Windows, v.4) as reviewed by Boethling et al., 1994; Howard et al., 1987; Howard et al., 1992; and Tunkel et al., 2000, used as part of the EPIWIN 3.05 (7/30/02) Suite (Syracuse Research Corporation). Howard, P. H. et al. (1992). Environ. Toxicol. Chem., 11:593-603. Howard, P. H. et al. (1987). Environ. Toxicol. Chem., 6:1-10. Boethling, R. S. et al. (1994). Environ. Sci. Technol., 28:459-65. Tunkel, J. et al. (2000). Environ. Toxicol. Chem., 19(10):2478–2485.
Reliability:	Estimated value based on accepted model.

Additional References for Biodegradation: None Found.

3.5 Bioconcentration

Value:	BCF = 1.65. This BCF value suggests that bioconcentration potential in aquatic organisms is low.
Method:	The bioconcentration factor is calculated by Syracuse Research Corporation's BCFWIN Computer Program, version 2.14, which utilizes a linear regression based on the Log Kow for the compound.
GLP:	Not Applicable
Reference:	The estimation methodology used by BCFWIN is described in the following document prepared for the U.S. Environmental Protection Agency (OPPT): "Improved Method for Estimating Bioconcentration Factor (BCF) from Octanol-Water Partition Coefficient," SRC TR-97-006

	Octanol-Water Partition Coefficient," SRC TR-97-006 (2nd Update), July 22, 1997; prepared for Robert S. Boethling, EPA-OPPT, Washington, DC, Contract No. 68-D5-0012; prepared by William M. Meylan, Philip H. Howard, Dallas Aronson, Heather Printup, and Sybil Gouchie, Syracuse Research Corp., Environmental Science Center, 6225 Running Ridge Road, North Syracuse, NY 13212.
Reliability:	Estimated value based on accepted model.

Additional References for Bioconcentration: None Found.

4.0 Ecotoxicity

4.1 Acute Toxicity to Fish

Type:	**96-hour LC_{50}**
Species:	Fish
Value:	347 mg/L
Method:	Modeled, using log Kow of 1.19.
GLP:	Not Applicable
Test Substance:	4-Pentenenitrile
Results:	No additional data.
Reference:	Meylan, W. M. and P. H. Howard (1999). User's Guide for the ECOSAR Class Program, Version 0.993 (Mar 99), prepared for J. Vincent Nabholz and Gordon Cas, U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics, Washington, DC, prepared by Syracuse Research Corp., Environmental Science Center, Syracuse, NY 13210 (submitted for publication).
Reliability:	Estimated value based on accepted model.

Additional References for Acute Toxicity to Fish: None Found.

4.2 Acute Toxicity to Invertebrates

Type:	**48-hour EC_{50}**
Species:	*Daphnia*
Value:	352 mg/L
Method:	Modeled, using log Kow of 1.19.
GLP:	Not Applicable
Test Substance:	4-Pentenenitrile
Results:	No additional data.
Reference:	Meylan, W. M. and P. H. Howard (1999). User's Guide for the ECOSAR Class Program, Version 0.993 (Mar 99), prepared for J. Vincent Nabholz and Gordon Cas, U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics, Washington, DC, prepared by

	Prevention and Toxics, Washington, DC, prepared by Syracuse Research Corp., Environmental Science Center, Syracuse, NY 13210 (submitted for publication).
Reliability:	Estimated value based on accepted model.

Additional References for Acute Toxicity to Invertebrates: None Found.

4.3 Acute Toxicity to Aquatic Plants

Type:	**96-hour EC_{50}**
Species:	Green algae
Value:	210 mg/L
Method:	Modeled, using log Kow of 1.19.
GLP:	Not Applicable
Test Substance:	4-Pentenenitrile
Results:	No additional data.
Reference:	Meylan, W. M. and P. H. Howard (1999). User's Guide for the ECOSAR Class Program, Version 0.993 (Mar 99), prepared for J. Vincent Nabholz and Gordon Cas, U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics, Washington, DC, prepared by Syracuse Research Corp., Environmental Science Center, Syracuse, NY 13210 (submitted for publication).
Reliability:	Estimated value based on accepted model.

Additional References for Acute Toxicity to Aquatic Plants: None Found.

5.0 Mammalian Toxicity

5.1 Acute Toxicity

Type:	**Oral ALD**
Species/Strain:	Male rats/ChR-CD
Value:	2250 mg/kg
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study. 4-Pentenenitrile, as a solution in peanut oil, was administered in single doses by intragastric intubation to young adult male rats at levels of 200, 300, 450, 670, 1000, 1500, 2250, and 5000 mg/kg. Clinical signs and body weights were recorded. Survivors were sacrificed 14 days later without pathological evaluation.
GLP:	No
Test Substance:	4-Pentenenitrile, purity approximately 100%
Results:	Mortality occurred at ≥ 2250 mg/kg within 1 day. Toxic signs observed at lethal doses included salivation, chewing

signs observed at lethal doses included salivation, chewing motions, rapid respiration, and flaccid hindquarters. Rats receiving non-lethal doses of 1500, 1000, and 670 mg/kg had flaccid hindquarters, salivation, and a red nasal discharge. Dose levels of 450, 300, and 200 mg/kg also caused a red nasal discharge on the day of dosing. Weight loss occurred at all the non-lethal levels except 200 mg/kg. At 1500 mg/kg, the rat lost weight and was unkempt for 3 days after dosing. At 1000, 670, and 450 mg/kg, the rats lost weight for 2 days, but only an initial weight loss was recorded at 200 mg/kg.

Reference: DuPont Co. (1967). Unpublished Data, Haskell Laboratory Report No. 198-67, "Acute Oral Test" (November 8) (also cited in TACA fiche OTS0555651).

Reliability: High because a scientifically defensible or guideline method was used.

Additional Reference for Acute Oral Toxicity:

Data from this additional source support the study results summarized above. This study was not chosen for detailed summarization because the data were not substantially additive to the database.

Dietz, H. M. et al. (1991). J. Agric. Food Chem., 39(2):311-315.

Type: **Inhalation LC_{50}**

Species/Strain: Male rats/ChR-CD

Exposure Time: 4 hours

Value: 2550 ppm (95% confidence limits, 2350-2767 ppm)

Method: No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study.

Male rats (6/exposure level), weighing 250-289 g, were exposed to nominal concentrations of 616, 1308, 2265, 4606, 3292 (3292a; 1st exposure at this level), 3292 (3292b; 2nd exposure performed on different animals on subsequent day), 2948, or 2084 ppm 4-pentenenitrile in a 16 L bell jar for 4 hours. The test substance was metered at a uniform rate into a heated stainless steel T-tube by a syringe drive and vaporized under prepurified nitrogen. The test substance vapors were mixed with oxygen and carried into the bell jar. Houseline air was used as diluent to give the desired atmospheric concentration. For analysis, gas samples were taken periodically from the chamber exit and analyzed by a gas chromatographic method. Clinical signs and body weights were recorded during and post-exposure. Gross and

	weights were recorded during and post-exposure. Gross and histopathologic examinations were performed on 2 rats each at 1, 2, 7, and 14 days post-exposure. Tissues examined included lungs, liver, spleen, kidney, testes, and thymus. The other survivors were sacrificed 14 days post-exposure.
GLP:	No
Test Substance:	4-Pentenenitrile, purity approximately 100%
Results:	The analytical concentrations for the 616, 1308, 2084, 2265, 2948, 3292a, 3292b, 4606 ppm exposure levels were not specified, not specified, 2320, 1990, 2670, 2330, 2925, and 3170 ppm, respectively. Mortality was 0/6, 0/6, 0/6, 1/6, 2/6, 3/6, 5/6, and 6/6 at 616, 1308, 2265, 2084, 2948, 3292a, 3292b, and 4606 ppm, respectively. Death occurred from 2.5 hours of exposure through the night following exposure. At lethal concentrations, irregular respiration, incoordination, lacrimation, salivation, pale ears, tremors, cyanosis, and premortem convulsions were observed during exposure. At non-lethal doses, irregular respiration, incoordination, hindleg tremors, and red discharge from the nose were observed during exposure. Clinical signs observed post-exposure at lethal concentrations were hypersensitivity, and weight loss for 1-2 days followed by normal weight gain. Clinical signs observed post-exposure for non-lethal concentrations included incontinence and initial weight loss followed by normal weight gain. Gross and histopathologic examinations revealed no anatomical evidence of primary injury.
Reference:	DuPont Co. (1970). Unpublished Data, Haskell Laboratory Report No. 301-70, "Acute Inhalation Toxicity" (July 15) (also cited in TSACA fiche OTS0555686). DuPont Co. (1968). Unpublished Study Data (January 16).
Reliability:	High because a scientifically defensible or guideline method was used.

Additional References for Acute Inhalation Toxicity: None Found.

Type: **Dermal Toxicity:** No Data.

Additional Reference for Acute Dermal Toxicity:

Data from this additional source were not summarized because the test substance was a mixture or otherwise inappropriate.

DuPont Co. (1983). Unpublished Data, Haskell Laboratory Report No. 67-83, Acute Skin Absorption LD50 Test on Rabbits" (March 10) (also cited in TSCA Fiche OTS0570947).

Type:	**Dermal Irritation**
Species/Strain:	Male guinea pigs/Albino
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study. In a test for primary irritation, applications of 1 drop of the undiluted sample (100%) or of a solution in 1:1 acetone-dioxane containing 13% guinea pig fat (f.a.d.) (48% based on corrected specific gravity value) were applied to the intact shaved skin of 10 male albino guinea pigs. The reactions were observed after 1 and 2 days.
GLP:	No
Test Substance:	4-Pentenenitrile, purity approximately 100%
Results:	No skin reaction was observed 1 or 2 days after treatment with 100% (observed only 1 day after treatment) or 48% 4-pentenenitrile.
Reference:	DuPont Co. (1968). Unpublished Data, Haskell Laboratory Report No. 92-68, "Primary Skin Irritation and Sensitization Tests" (September 5).
Reliability:	High because a scientifically defensible or guideline method was used.

Additional References for Dermal Irritation: None Found.

Type:	**Dermal Sensitization**
Species/Strain:	Male guinea pigs/Albino
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study. In a test for sensitization potential, an exposure series was given during a 3-week interval. Five guinea pigs received 9 applications of 100% 4-pentenenitrile and 5 others received 4 intradermal injections (each 0.1 mL of 95%,

	received 4 intradermal injections (each 0.1 mL of 95%, based on corrected specific gravity value, solution in dimethyl phthalate). A 2-week rest period was followed by a challenge test consisting of applications of 100% test substance and 48% solution (based on corrected specific gravity value) in 1:1 acetone-dioxane containing 13% guinea pig fat (f.a.d.) to both intact and abraded skin. Sensitization reactions were observed at 1 and 2 days.
GLP:	No
Test Substance:	4-Pentenenitrile, purity approximately 100%
Results:	Sensitization reactions at the challenge phase included 2 and 1 guinea pigs with mild erythema at 100% and 48%, respectively, in intact skin at the 1-day observation. At the 2-day observation for intact skin and at 1 and 2 days for abraded skin no erythema was observed. 4-Pentenenitrile was not a skin sensitizer when tested in albino guinea pigs.
Reference:	DuPont Co. (1968). Unpublished Data, Haskell Laboratory Report No. 92-68, "Primary Skin Irritation and Sensitization Tests" (September 5).
Reliability:	High because a scientifically defensible or guideline method was used.

Additional References for Dermal Sensitization: None Found.

Type:	**Eye Irritation**
Species/Strain:	Rabbits/Albino
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study. Undiluted 4-pentenenitrile (0.1 mL) was instilled into the right conjunctival sac of each of 2 albino rabbits. Twenty seconds after contact, 1 exposed eye was washed with tap water for 1 minute. The exposed eye of the other rabbit was not washed. Observations were made with a hand slit lamp at 1 and 4 hours, and at 1, 2, 3, and 7 days. Fluorescein stain and a biomicroscope were used at examinations after the day of treatment.
GLP:	No
Test Substance:	4-Pentenenitrile, purity approximately 100%
Results:	4-Pentenenitrile produced mild conjunctivitis of the rabbit eye, but had no significant effect on the iris or cornea.
Reference:	DuPont Co. (1968). Unpublished Data, Haskell Laboratory Report No. 92-68, "Eye Irritation Test" (September 5).
Reliability:	High because a scientifically defensible or guideline method was used.

Additional References for Eye Irritation: None Found.

5.2 Repeated Dose Toxicity

Type:	**2-Week Inhalation Study**
Species/Strain:	Rats/ChR-CD
Sex/Number:	Male/6
Exposure Period:	2 weeks (total of 10 exposures)
Frequency of Treatment:	4 hours per day
Exposure Level:	550 ppm
Method:	No specific test guideline was reported; however, a scientifically defensible approach was used to conduct the study. Six male rats, weighing 250-289 g, were exposed to 4-pentenenitrile in a 16 L bell jar for 4 hours/day for 2 weeks. The test substance was metered at a uniform rate into a heated stainless steel T-tube by a syringe drive and vaporized under prepurified nitrogen. The test substance vapors were mixed with oxygen and carried into the bell jar. Houseline air was used as diluent to give the desired atmospheric concentration. For analysis, gas samples were taken periodically from the chamber exit and analyzed by gas chromatography. Clinical signs were recorded during and post-exposure. Gross and histopathologic examinations were performed, and included lungs, liver, spleen, kidney, testes, and thymus.
GLP:	No
Test Substance:	4-Pentenenitrile, purity approximately 100%
Results:	At 550 ppm, no mortality was observed. Clinical signs during exposure included mild hyperemia and slight irregular respiration. Post-exposure, animals had normal weight gain, and no clinical signs were observed. Gross and histopathologic examination showed no evidence of primary injury by the test substance.
Reference:	DuPont Co. (1970). Unpublished Data, Haskell Laboratory Report No. 301-70, "Subacute Inhalation Toxicity" (July 15) (also cited in TSCA fiche OTS0555686).
Reliability:	Medium because a suboptimal study design was used.

Additional Reference for Repeated Dose Toxicity:

Data from this additional source were not summarized because the study design was not adequate.

Gagnaire, F. et al. (1998). J. Appl. Toxicol., 18(1):25-31.

5.3 Developmental Toxicity: No Data.

5.4 Reproductive Toxicity: No Data.

5.5 Genetic Toxicity

Type: ***In vitro*** **Bacterial Reverse Mutation Studies:** No Data.

Type: ***In vitro*** **Clastogenicity Studies:** No Data.

Type: ***In vivo*** **Studies:** No Data.